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MISA

Municipal/Industrial Strategy for Abatement

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Clean Water Regulation for the Electric Power Generation Sector - Effluent Monitoring and Effluent Limits

Ontario

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Draft Development Document

Clean Water Regulation for the Electric Power Generation Sector - Effluent Monitoring and Effluent Limits

Report Prepared by:

Program Development Branch
Industrial Effluents Section
Ontario Ministry of Environment and Energy

October 1994

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Draft Development Document
Clean Water Reulation for the Electric Power Generation Sector - Effluent Monitoring and Effluent Limits

Contents

Section		Page
Preface		1
Executive Summary		3
Section 1.0	Introduction	1 - 1
Section 2.0	Sector Overview	2 - 1
Section 3.0	Wastewater Effluent	3 - 1
Section 4.0	Best Available Technology	4 - 1
Section 5.0	Effluent Limits	5 - 1
Section 6.0	The Effluent Monitoring and Effluent Limits Regulation	6 - 1
Appendix A	Draft Effluent Monitoring and Effluent Limits Regulation for the Electric Power Generation Sector	A - 1
Appendix B	Summary of MISA Monitoring Results	B - 1
Appendix C	MISA Toxicity Results	C - 1
Appendix D	Power Production versus Flow/Loadings	D - 1

Preface

The Municipal - Industrial Strategy for Abatement (MISA) was announced by the Ministry of Environment and Energy in June 1986. The ultimate goal of this strategy is the virtual elimination of persistent toxic contaminants from all discharges into Ontario's waterways.

The Ministry mandate under the MISA program was the development of technology based effluent limits for the Electric Power Generation Sector (EPGS). The regulation development involved two phases. In the first phase, an effluent monitoring regulation was promulgated in 1989 requiring all direct dischargers in the EPGS to monitor their point source effluents. In the second phase, effluent limits were developed based on the effluent monitoring data and best available technology. It should be noted that the three Atomic Energy of Canada Limited sites monitored in phase one have been excluded from this regulation and no further reference is made in this document.

This document describes the steps involved in the development of the effluent limits and contains the technical rationale and approach used in developing the regulation.

The development document is organized in six sections and four appendices (A to D). In addition Section 5 has it's own appendix.

Section 1 is introductory and presents a short summary of the MISA regulation development process. The salient features of the Effluent Monitoring and Effluent Limits Regulation are summarized.

Section 2 is an overview of the Electric Power Generation Sector. All facilities included in the sector are described including a brief discussion of the processes, capacity and location.

Section 3 provides an in depth discussion of the wastewaters monitored under the first phase of the program (Effluent Monitoring Regulation, 1989). This section provides information on each effluent type sampled during the MISA monitoring period (June 1, 1990 to May 31, 1991), including wastewater volumes, sources, treatment technologies in place and toxicity data collected. Appendix B at the end of the document contains average concentration and loading data for parameters. Appendix C is a summary of toxicity data gathered under the monitoring regulation.

Section 4 describes the Best Available Technology (BAT) options identified and studied by the Ministry consultant. Five BAT options were studied for the fossil subcategory, four BAT options for the nuclear subcategory and two for the nuclear associated facilities. Also discussed is an additional option developed by the BAT Subcommittee covering the treatment of ash quench and boiler seal water overflows at three fossil stations. Section 4 also examines the implementation costs of BAT options studied.

Section 5 describes the selection of the "option" and corresponding parameters to be limited. The rationale for choosing concentration based limits is discussed in detail. Each step in determining the effluent limits is documented and the method of arriving at the numerical limits is explained. The impact of implementing the regulation including estimated contaminant loading reductions is also discussed. Appendix to Section 5 contains detailed tabulated rationale for short-listing the candidate parameters for limits.

Section 6 explains the key sections of the regulation. The regulation is organized in ten parts consisting of 36 Sections. The draft regulation has not received legal review nor has it been approved by the Minister. However, the structure is based on the template used by other sectoral regulations.

The draft Effluent Monitoring and Effluent Limits Regulation is presented in Appendix A and Appendix D shows plots of wastewater flow/TSS loading and power produced.

Executive Summary

The Development Document for the Clean Water Regulation for the Electric Power Generation Sector Effluent Monitoring and Effluent Limits (EPGS regulation) is one of nine sectoral regulations developed under the MISA program. This document describes and discusses the steps taken in the development of the EPGS regulation.

Under the Effluent Monitoring Regulation for the EPGS, direct discharge plants were required to conduct one year of comprehensive effluent monitoring starting on June 1, 1990. Up to 153 parameters including, 18 conventional, were monitored according to subcategory specific and site specific monitoring schedules for specified parameters at daily, thrice weekly, monthly and quarterly sampling frequencies.

In total about 430 000 pieces of data were collected including 46 000 pieces of quality assurance and quality control data. The effluent monitoring data were used to select candidate parameters for effluent limits setting. A parameter was selected unless the monitoring data for any process effluent showed, at a 95% confidence level, that 90% of the data for a parameter in an effluent were at concentrations less than the parameters regulation method detection limit.

Up to forty parameters were selected as candidate parameters for the fossil subcategory and for the nuclear/nuclear associated subcategory. A parameter was selected for a plant subcategory if it was selected in any one plant in the subcategory.

Selected parameters were dropped from further consideration if Quality Assurance/Quality Control (QA/QC) assessment showed that their presence in the effluent was highly suspect or if the effluent data were of limited or unreliable quality for the purpose of setting limits.

The Ministry hired a consultant, AWT/ Metcalf and Eddy to assess the current pollution control technologies at the sector sites and develop Best Available Technology (BAT) Options, using an inventory of Global Technologies used in this sector. The study to develop an inventory of available global technologies used in this sector was conducted by the sector hired consultant, Bechtel Canada Inc. in consultation with the Ministry. From the list of available technologies in the Bechtel Canada Inc. study, the Ministry consultant was asked to identify up to five best available technology options that could be applied to the Ontario plants and to assess technical feasibility, capital costs, operating, maintenance and administrative (OM&A) costs and resultant effluent quality (loading reductions) if these BAT

options were implemented at the respective Ontario plants.

The five BAT options (I through V) identified by the consultant for the fossil subcategory (six plants) are Best in Ontario (I), Environment Canada Codes of Practice (II), No Discharge of Proven Toxic Streams (III), Minimum Discharge (IV) and Best in Canada - Zero Discharge (V).

Following completion of the BAT studies another option was developed in consultation with Ontario Hydro: Treatment of Boiler Ash Quench and Seal Water at three fossil stations (IA). These process effluent had not been monitored under the phase one monitoring program prior. These streams are similar in characteristics to untreated ash transport waters.

The four BAT options (I through IV) identified by the consultant for the nuclear subcategory (four plants) are Best in Ontario (1), Environment Canada Codes of Practice (II), Partial Reduction of Toxic Streams (III) and Minimum Discharge (IV).

The two BAT options (I & II) identified by the consultant for the three nuclear associated facilities are Environment Canada Codes of Practice (I) and Minimum Discharge (II).

No BAT options were developed for the hydraulic stations and the consultant recommended that suitable best management practices be implemented at these facilities.

Capital and operating cost estimates for all the above options were developed and corresponding loading reductions from a defined baseline were computed.

The Ministry conducted an economic assessment for all the options and identified the case for developing the draft regulation. This case is primarily based on Option 1A for the fossil subcategory, the treatment of filter back washes at Bruce B water treatment plant and the removal of acute toxicity found in the discharges at the nuclear station radioactive liquid waste management system effluent.

At the request of the Ministry Ontario Hydro has developed the following revised cost estimates for implementing the regulation as documented in their letter dated October 5, 1994:

Estimate	Fossil, $ million	Nuclear/Associated, $ million
Capital	75 $\pm$ 10%	35 - 70
OM&A	4 $\pm$ 10%	7 - 10

The economic impact of these expenditures on Ontario Hydro is summarized in the following table:

(All units in millions of dollars unless otherwise stated)

Estimate	Fossil	Nuclear/Associated	TOTAL, EPGS
Capital	$ 68 - $ 83	$ 35 - $ 70	$ 103 - $ 153
OM & A	$ 4 - $ 5	$ 7 - $ 10	$ 11 - $ 15
Total annualized cost	$ 11 - $ 13	$ 11 - $ 18	$ 22 - $ 31
Electricity Price Increase	-	-	0.4 % to 0.5%
Or Net Income Reduction	-	-	$ 22 - $ 31
Percent of annual 1993 environmental expenditure	-	-	6 % to 8 %

The salient features of the draft EPGS regulation are summarized below:

- toxicity limits and concentration limits for 10 parameters with four parameters applying to a majority of the effluent:

  pH
  TSS
  Aluminum
  Iron
  Ammonia + Ammonium
  Zinc
  Phosphorus
  Sulphide
  Oil & Grease
  BOD_5

  Acute Toxicity

- building effluent assessment monitoring for two parameters and toxicity limits:

  TSS
  Oil & Grease
  Acute Toxicity

- chronic toxicity testing of process effluent
- a storm water control study will be required at each site
- three years from promulgation for compliance
- self-monitoring for compliance and reporting of results
- comprehensive reporting requirements prescribed

The implementation of the draft regulation will result in an estimated 73% reduction in total suspended solids load (which includes toxic heavy metals) to the environment. The annual estimated total limited parameter removal is 770 tonnes.

Section 1

Electric Power Generation Sector
Introduction

Section 1
Introduction

Contents

Section		Page
1.0	Introduction	1
1.1	The MISA Program	1
1.2	The Effluent Limits Regulation Development Process	2
1.3	The Effluent Limits Regulation for the Electric Power Generation Sector	3
1.4	References	5

1.0 Introduction

1.1 The MISA Program

The Municipal-Industrial Strategy for Abatement (MISA) is a regulatory program of the Ontario Ministry of Environment and Energy for reducing water pollution from both industrial and municipal dischargers. The ultimate goal of MISA is the virtual elimination of persistent toxic contaminants from all discharges into Ontario's waterways. The MISA program was first announced by the Ontario Ministry of Environment and Energy in the White Paper dated June 1986[1].

Under the MISA program for the Electric Power Generation Sector (EPGS), technology-based effluent limits were developed and are being imposed on direct discharges from fossil and nuclear power generating stations and also a number of facilities associated with nuclear stations. Effluent qualities specified in the regulation are a minimum pollution control requirement. If added protection to sensitive receiving water bodies is required, then more stringent effluent limits can be imposed on a site-specific basis.

The Ministry used a two phase process to develop the technology-based effluent limits for the electric power generation sector. Under the first phase, the Effluent Monitoring Regulation for the EPGS was promulgated in 1989 requiring all direct discharges from EPGS sites to monitor their effluent streams for specified parameters at regular intervals according to specific sampling, analytical and Quality Assurance/Quality Control (QA/QC) protocols and procedures. Monitoring was conducted over a period of one year (June 1, 1990 to May 31, 1991) and produced a large data base on the quality of effluents discharged from sites in the EPGS.

The requirements of the Effluent Monitoring Regulation for the Electric Power Generation Sector are presented in Ontario Regulation 726/89[2].

Under the second phase, a draft effluent limits regulation for the EPGS has been developed with participation of industry and other stake-holders. Consultation with the primary stake-holders was facilitated through the EPGS Joint Technical Committee (JTC), composed of representatives from the Ministry, Environment Canada, Ontario Hydro and the MISA Advisory Committee (MAC). The Joint Technical Committee and several working subcommittees provided the opportunity for the dischargers to have input to the regulation development.

The Ministry is committed to keeping well informed on pollution prevention technology and the effluent limits regulation for the EPGS will be reviewed and amended as new developments take place. Through this process of ongoing evaluation and step-by-step reductions, MISA's ultimate goal to virtually eliminate the discharge of toxic contaminants will be achieved for the EPGS. Such a goal fulfils Ontario's commitment to the protection and improvement of our natural water resources, and is consistent with the provisions of the Canada-Ontario Agreement Respecting Great Lakes Water Quality[3] and the Canada-United States Great Lakes Water Quality Agreement[4].

1.2 The Effluent Limits Regulation Development Process

In 1989, the Ministry initiated the MISA Issue Resolution Process in order to establish standard procedures and criteria for the development of consistent and equitable effluent limits regulations for all sectors. Special Issue Resolution Committees (IRC) were formed to work out details of the process. The committee members included representatives from the Ministry, industry and municipalities. Environment Canada and the MISA Advisory Committee were requested to comment on the proposed effluent limits development process and their comments and concerns were carefully assessed during the decision-making process.

The process described in the IRC final report[5] summary and the IRC report[6] was followed when developing the effluent limits regulation for the EPGS. The process consisted of the following basic steps:

Step 1: Effluent Monitoring

Under the effluent monitoring regulation for the EPGS, direct dischargers were required to conduct one year of effluent monitoring for a comprehensive list of contaminants. Up to 153 parameters were monitored on a daily, thrice weekly, weekly, monthly and quarterly basis for process effluent, cooling water effluent, storm water effluent, emergency overflow effluent, potentially contaminated building effluent and waste disposal site effluent.

Step 2: Candidate Parameter Selection

Statistical tests were applied to the effluent monitoring data to determine potential candidate parameters for effluent limits setting. A parameter was selected for effluent limits setting unless, the effluent monitoring data

for any process effluent showed that a statistically determined 90% of the data was less than the regulation method detection limit for that parameter for that process effluent stream.

Step 3: QA/QC Data Assessment

Quality assurance/quality control (QA/QC) data were used to evaluate the validity of the effluent monitoring data for use in the effluent limits setting process. Data which were considered suspect or unreliable were eliminated from further consideration.

Step 4: Best Available Technology (BAT) Identification

Available pollution control technologies were identified and BAT options, representing different levels of pollution control and abatement, were determined. The BAT options were reviewed in order to identify the parameters that would be treated if the options were installed at Ontario EPGS sites. The retrofit costs for installation of identified BAT options and corresponding key contaminant reductions were also estimated.

Step 5: Economic Assessment

The costs of installing the various BAT options and estimates of corresponding pollutant reductions were used to develop abatement cost functions which show the relationship between increasingly stringent levels of control and the corresponding costs of achieving them. The financial and economic consequences associated with imposing the different levels of pollution control were very influential in determining the BAT option used to base the effluent limits for the EPGS.

Step 6: Effluent Limits Setting

Effluent limits were developed using the performance data from the power stations with BAT treatment following general procedures outlined in the Issue Resolution Committee Report chapters on Monitoring Data Analysis and Limit Setting and Form of Limits[6].

1.3 The Effluent Limits Regulation for the Electric Power Generation Sector

The effluent limits regulation for the EPGS[7] specifies all the legal discharge requirements that each EPGS site must meet upon promulgation. The requirements are related to the

quality (concentration limits) of effluent discharged, acute and chronic toxicity testing, flow measurement and reporting.

The effluent limits regulation states that:

- Effluent quality must be within specified daily and monthly average maximum allowable concentration limits. Depending on the site limits are specified for the parameters total suspended solids, aluminum, iron, zinc, total phosphorus, biological oxygen demand, oil & grease, sulphide and ammonia + ammonium.
- EPGS sites must not discharge effluent acutely lethal to rainbow trout and Daphnia magna (water fleas)
- EPGS sites must conduct chronic toxicity tests following twelve months of non-lethal acute lethality test results.
- EPGS sites must discharge effluent between the pH range of 6.0 to 9.5
- EPGS must conduct assessment monitoring of building effluent.

The effluent limits regulation will be promulgated under Section 136 of the Ontario Environmental Protection Act and will require EPGS sites to achieve regulatory compliance from the first day of the fourth year from the date of promulgation of the regulation. This interval is provided to ensure that the EPGS sites have sufficient time to implement the necessary pollution prevention and control strategies and to install necessary capital equipment where necessary.

1.4 References

1. Ontario Ministry of the Environment, Municipal-Industrial Strategy for Abatement (MISA), A Policy and Program Statement of the Government of Ontario on Controlling Municipal and Industrial Discharges into Surface Waters, Water Resources Branch, Toronto, Ontario, June 1986.

2. Government of Ontario, Ontario Regulation 726/89 under the Environmental Protection Act - Effluent Monitoring - Electric Power Generation Sector, Queens Park, December 1989.

3. Canada-Ontario Agreement respecting Great Lakes Water Quality, signed March 1986.

4. International Joint Commission, Great Lakes Water Quality Agreement with annexes and terms of reference between the United States and Canada, Ottawa, November 1978.

5. Ontario Ministry of the Environment, MISA Issues Resolution Process Final Report Summary, Toronto, Ontario. September 1991.

6. Ontario Ministry of the Environment, MISA Issues Resolution Process - Issue Resolution Committee Reports, Toronto, Ontario, June 1990.

Section 2

Electric Power Generation Sector
Sector Overview

Section 2
Sector Overview

Contents

Section		Page
2.0	Overview of the Electric Power Generation Sector	1
2.1	Industry Profile	1
2.2	Power Production Process	4
2.3	Bruce Heavy Water Plant	6
2.4	Bruce Nuclear Power Development Services	7
2.5	Darlington Construction Site	8
2.6	References	13

List of Tables

Table		Page
2.1	Ontario Hydro Power Generation - 1991	3
2.2	Ontario Hydro Nuclear Associated Facilities	4
2.3	1991 Fossil Station Fuel Consumption / Ash Production	5

List of Figures

Figure		Page
2.1	Electric Power Generation Sector Location Map	2
2.2	Cross Sectional View of a Typical Hydraulic Generating Station	9
2.3	Cross Sectional View of a Typical Fossil Fuelled Thermal Generating Station	10
2.4	Cross Sectional View of a CANDU Nuclear Powered Thermal Generating Station	11
2.5	Heavy Water Enriching Process	12

2.0 Overview of the Electric Power Generation Sector

This section serves as an introduction to the Electric Power Generation Sector (EPGS) in Ontario. It describes the facilities included in the sector and provides an overview of the production processes.

2.1 Industry Profile

The Electric Power Generation Sector (EPGS) consists of facilities which produce or are associated with the production of electric power. In total there are eighty power generating stations in the sector consisting of sixty-eight hydraulic powered, four nuclear powered and eight fossil fuelled stations. Two of the eight fossil fuelled stations are moth-balled. The sector also includes three facilities which do not generate power but are associated with the generation of nuclear power. The nuclear associated facilities include a heavy water plant, a nuclear services facility and the construction site at Darlington nuclear station which was only partially complete during the MISA monitoring period.

All facilities included in the EPGS are owned and operated by Ontario Hydro, a provincial crown corporation[a].

Information on the location, generating capacity and 1991 energy output for each facility monitored under the MISA Effluent Monitoring Regulation are provided in Tables 2.1 and 2.2. The location of each facility is also indicated on Figure 2.1. Today, nuclear powered stations provide about one half of the electricity used in the province, hydraulic and fossil powered stations each provide about one quarter. Generally, hydraulic and nuclear stations are used to maintain a base level of electrical output (base-load stations), whereas fossil fuelled stations are operated primarily during periods of peak demand since their units can be stated up or shut-down within a few hours as demand changes (peaking stations). The capacity factor (Table 2.1) indicates the percentage energy output of the total in-service capacity available over the 1991 year.

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[a] The corporation is governed by a Board of Directors which can have up to 17 members, 16 of whom are appointed by the Lieutenant-Governor-in Council of Ontario. The President and Chief Executive Officer, also a board member, is a full time employee of Ontario Hydro and appointed by the Board. Ontario Hydro is financially self-sustaining without share capital. Bonds and notes issued by the corporation are guaranteed by the Province.[1] In 1991, Ontario Hydro employed approximately 28,000 regular and 6,000 part-time and temporary staff.

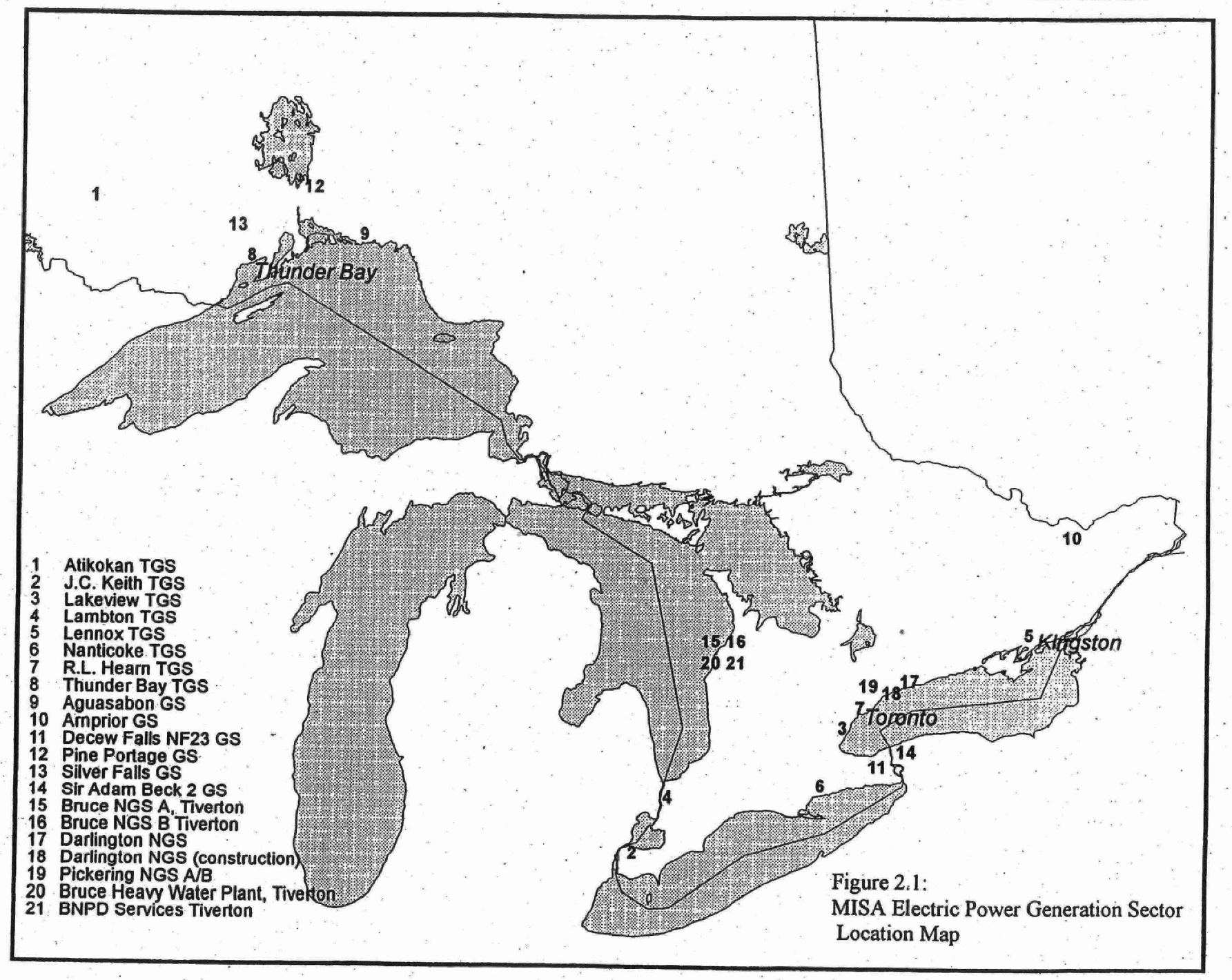


Figure 2.1:
MISA Electric Power Generation Sector
Location Map

Table 2.1
Ontario Hydro Power Generation - 1991

Location/Receiving Water	Station	Design Capacity MW	Number of Units	Energy Output[1] (Net) MW.h	Capacity[a] Factor %	Number of Employees
	Nuclear Generating Stations					
Tiverton/Lake Huron	Bruce-A and Bruce-B	6,736	8	42,815,973	75	1,730
Bowmanville/Lake Ontario	Darlington[b]	3,524[b]	4	1,962,279	12.7	850
Pickering/Lake Ontario	Pickering A&B	4,124	8	25,994,312	72	1,635
	Total Nuclear Generation	14,384	20	70,772,564		~4,215
	Fossil Generating Stations					
Atikokan/Snow Lake	Atikokan	200	1	660,806	36.4	105
Windsor/Detroit River	J.C. Keith[c]	264	4	(4,864)		0
Toronto/Lake Ontario	R.L. Hearn[c]	1200	8	(21,614)		30
Mississauga/Lake Ontario	Lakeview	2,400	8	4,003,433	21.5	500
Courtright/St Clair River	Lambton	2,040	4	5,802,565	34.0	479
Kingston/Lake Ontario	Lennox	2,240	4	866,475	5.2	218
Nanticoke/Lake Erie	Nanticoke	4,096	8	17,547,647	50.9	690
Thunder Bay/Mission River	Thunder Bay	400	2	1,139,804	43.9	185
	Other (Combustion Turbine & Diesel-Electric)[d]	256	-	17,463		N.A.
	Total Fossil Generation	13,096	39	30,011,715		~2,207
	Hydraulic Generating Stations					
Aguasabon River	Aguasabon	44	-	265,459	67	unmanned
Madawaska River	Arnprior	80	-	144,639	21	unmanned
Welland Canal	DeCew Falls No. 2	144	-	935,442	81	unmanned
Nipigon River	Pine Portage	132	-	670,037	68	unmanned
Kaministikwia River	Silver Falls	48	-	201,635	50	unmanned
Niagara River	Sir Adam Beck-Niagara No.2	1,328	-	9,349,398	81	80
	Other Hydraulic Stations[d]	4,866	-	22,361,607		N.A.
	Total Hydraulic Generation	6,642	-	33,928,217		N.A.
	Total Generation	34,122		134,712,496		

Notes:

a: Capacity factor = actual energy produced divided by the in-service production capacity. Capacity factors for fossil stations are actual[7]. Capacity Factors for nuclear and hydraulic stations are estimated from annual energy output and in-service capacity during December peak demand period[1].
b: Darlington NGS was not fully operational during MISA monitoring period.
c: Mothballed Station
d: Not Monitored
N.A. = Not Available

Table 2.2
Ontario Hydro Nuclear Associated Facilities

Location/Receiving Water	Nuclear Associated Facility	Design Capacity	1991 Production	# Employees
Tiverton/Lake Huron	Bruce Heavy Water Plant	800 tonnes/yr	unknown	500
Bowmanville/Lake Ontario	Darlington Construction Site	N/A	N/A	7000 (peak)
Tiverton/Lake Huron	Bruce Nuclear Power Development Services	N/A	N/A	unknown

Notes: N/A = Not Applicable

With the exception of hydraulic stations, effluents from all facilities were monitored under the MISA monitoring regulation. In order to reduce the costs of monitoring, six hydraulic stations were chosen to be monitored as representative of all sixty-eight hydraulic stations[2]. Representative monitoring of hydraulic stations was considered sufficient because waste effluents and contaminants released from hydraulic stations are minimal and because of the similar processes used at all hydraulic stations.

2.2 Power Production Process - Hydraulic, Fossil and Nuclear

The principle of generating electricity is that an electric current is produced in a copper wire if the wire is moved quickly through a magnetic field between two magnets. In large electric generators, called "turbo-generators", many loops of wire are mounted around the circumference of the machine. Thus, the magnetic lines of force produced by electromagnets mounted on the rotor shaft "cut" many more wires as they spin around, and more electricity is produced. This is the basic technique by which electric power is generated at hydraulic, fossil-fuelled and nuclear-powered generating stations in Ontario. The main difference in the three categories lies in the technology employed to rotate the generator shaft.

In a hydraulic station the power to rotate the generator shaft is provided by turbines driven by the force of falling water. After passing through the turbines the water is returned to the river downstream (Figure 2.2)[2].

Steam is used at fossil and nuclear generating stations to drive generator turbines. Once the high-pressure steam has expended its energy on the turbine blades, to make more efficient use of the energy remaining in the steam, it is reheated and fed to a second turbine stage at lower pressure. For efficient boiler operation, large heat exchangers utilizing lake or river

water are then used to assist in cooling and condensing the steam back to water (condensate). Condensate is recycled back to the boiler where it is converted to steam again and continues through the closed steam cycle. Additional make-up demineralized water is added continuously to compensate for leaks and boiler blowdown.

High-pressure (HP) steam is produced from demineralized water using heat generated from;
a) the combustion of fossil fuels or
b) nuclear energy - the fission (splitting) of uranium-235 atoms.

a) Fossil Fuels: All of Ontario Hydro's fossil plants (Figure 2.3)[3], except for Lennox, burn coal as fuel. Lennox burns oil. Coal is crushed, pulverized into a fine powder and blown into the furnace with air where it is ignited. Residual fuel oil is preheated and atomized to create a large surface area for complete combustion. The heat generated from combustion is used to produce high pressure steam (538 - 546 °C) which is then used to drive the generating turbines.

Mineral matter, always present in fossil fuels, forms ash when the fuel is burned. Extensive facilities are required to collect, remove and dispose of ash and represent a significant cost in terms of equipment and space requirements for coal fired stations. The ash content of coal varies over a wide range (6 to 20%). Ash is normally directed to a temporary storage facility for eventual disposal to landfill sites; however, in recent years flyash has been finding commercial applications in concrete, as land fill, and several other related commercial processes. Fuel consumption/ash production (1991) for fossil fuelled stations is provided in Table 2.3.

Table 2.3[7]
1991 Fossil Station Fuel Consumption/Ash Production

Station	Fuel Burned (Mg)[note]	Ash Produced (Mg)
Atikokan	453,551	44,000
Lakeview	1,406,346	109,000
Lambton	1,992,069	181,000
Lennox	250,266	7,717
Nanticoke	6,288,515	595,000
Thunder Bay	755,487	30,000

note: Coal is burned at all stations except Lennox. Lennox burns oil.

b) Nuclear Power: Ontario Hydro's four nuclear sites employ CANDU (CANada Deuterium Uranium) reactors (Figure 2.4)[4]. The CANDU reactor design uses natural uranium as fuel, composed of approximately 99.3% uranium-238 and 0.7% uranium-235. It is the unstable properties of the uranium-235 atom which are used for the production of nuclear power. Uranium-235 atoms can be split if struck by a neutron resulting in the production of an enormous quantity of heat and also neutrons that are capable of splitting other uranium-235 atoms. Neutrons released from the splitting of a uranium-235 atom travel so fast that the probability of colliding with another uranium-235 atom is small; therefore, in the CANDU reactor design, the uranium fuel is surrounded by a heavy water moderator. The purpose of the heavy water is to slow down or "moderate" free neutrons and increase the probability of collision with other uranium-235 atoms. This produces a self-sustaining chain reaction and the constant heat needed to generate steam. The heavy water also serves as a heat transport medium to carry heat from the reactors to boilers where demineralized water is converted to steam.

Uranium fuel is clad in zirconium alloy as a bundle which is about 0.5 of a meter in length, 15mm in diameter, and 22 kg in weight. A fuel charge for one reactor consists of approximately 4,700 bundles weighing over 110 tons. Once these bundles have been consumed, they are highly radioactive and are stored under water in the spent fuel storage bays at each station. Other low/intermediate level solid radioactive wastes are sent to Bruce Nuclear Power Development Services for storage.

Nuclear Associated Facilities

2.3 Heavy Water Production - Bruce Heavy Water Plant (BHWP)

The Bruce Heavy Water Plant (BHWP) was constructed to supply all Ontario Hydro nuclear generating stations with heavy water (D_2O).

Reactor grade heavy water is produced by concentrating the D_2O contained in lake water to 99.9+% purity. Deuterium is a naturally occurring isotope of hydrogen with surface waters containing about 148 ppm of D_2O. Heavy water is produced using two processes. First, D_2O is concentrated to about 30% by extracting deuterium using hydrogen sulphide gas (H_2S). This extraction, or "enriching process", is carried out in a series of trayed towers. Hydrogen sulphide gas is blown up through the sieve trays, counter-current to lake water which cascades down through the trays. Each enriching tower has a hot section and a

cold section. The deuterium isotope migrates to the liquid phase (water) at a low temperature and to the gas phase (H_2S) at a higher temperature (Figure 2.5)[5]. After three stages of extraction, enriched water (D_2O ~ 30%) is drawn off between the hot and cold sections. In the second step, enriched water passes to a vacuum distillation process where D_2O is further concentrated to a 99.92% reactor grade product.

On average, a total of 340,000 tonnes of lake water is used for each tonne of heavy water produced. Approximately 34,000 tonnes of the lake water is used for the actual extraction process, with the remainder being utilized for cooling purposes.

The BHWP has an annual capacity of approximately 800 Mg of heavy water. For its initial fill-up a nuclear reactor requires approximately 800 tonnes of heavy water (a year's production from the BHWP); however, once filled, they require less than 1% of their starting intake, annually, to replace the amount lost in each reactor.

2.4 Bruce Nuclear Power Development (BNPD)

Bruce Nuclear Power Development (BNPD) is responsible for providing services to nuclear generating stations and to the Bruce Heavy Water Plant. The primary operations ongoing at Bruce Services are described below[6];

The Bruce Bulk Steam System: The primary purpose of the BBSS is to supply the Bruce Heavy Water Plant (BHWP) with medium pressure (MP) steam for the production of heavy water. High pressure steam from Bruce-A is converted to medium pressure steam in steam transformer plant - A (STP-A). STP-O is available to provide backup MP steam in the event that Bruce NGS-A cannot provide enough steam to STP-A. High pressure steam is supplied to STP-O by the oil fired Bruce steam plant.

Sewage Treatment: An activated sludge treatment plant at BNPD receives all sewage produced at the BNPD site which includes Bruce-A, Bruce-B, the Bruce Heavy Water Plant and Bruce Nuclear Power Development.

Disposal of Radioactive and Non-radioactive Waste: The purpose of the radioactive waste storage site is to provide safe, retrievable storage for the solid radioactive waste produced by Ontario Hydro. Wastes with high radiation fields are placed in an appropriate storage structure. Incinerable wastes are burned in the radioactive incinerator and the ashes stored in a low level radiation storage building.

2.5 Darlington Construction Site

The Darlington Nuclear Generating Station was under construction during the 1990/91 MISA monitoring period. The Darlington construction site was subject to the MISA Effluent Monitoring Regulation because wastewaters are produced on the construction site which discharge directly to Lake Ontario and although some of the effluents associated with the construction site are temporary, others will be ongoing wastewaters associated with the completed Darlington NGS.

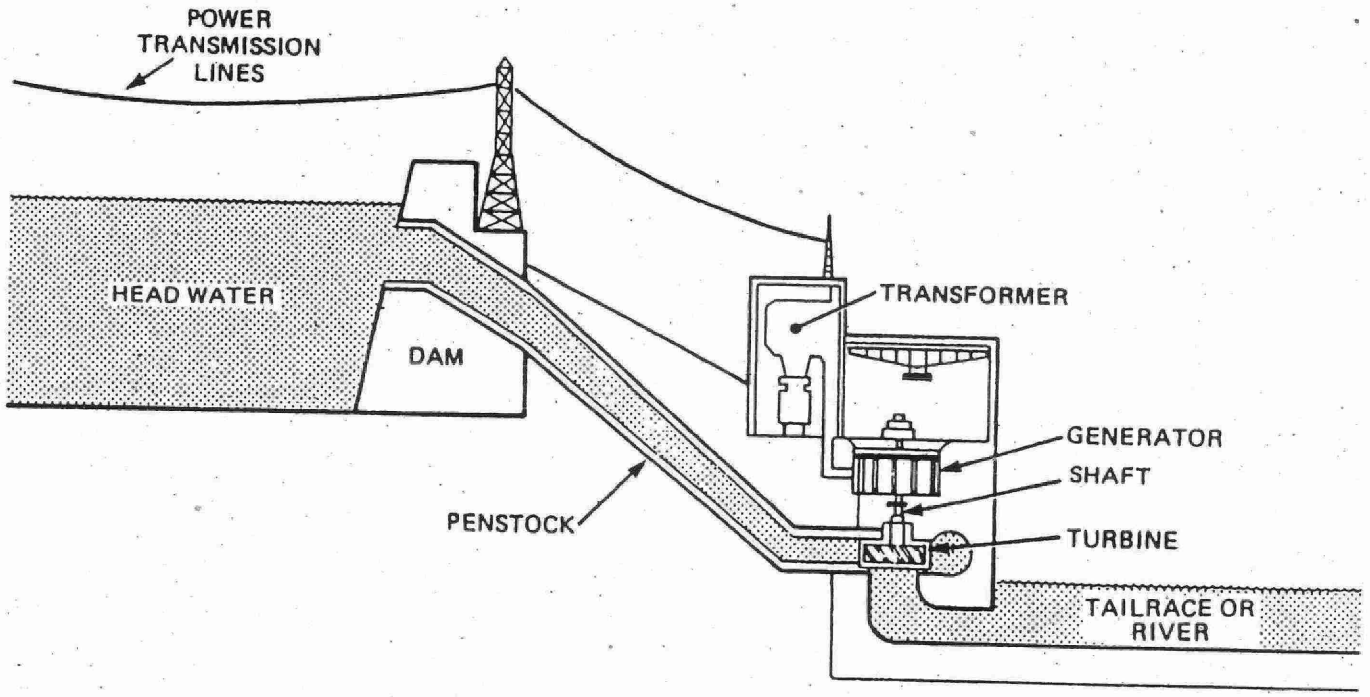


Figure 2.2
Cross Sectional View of a Typical
Hydraulic Generating Station

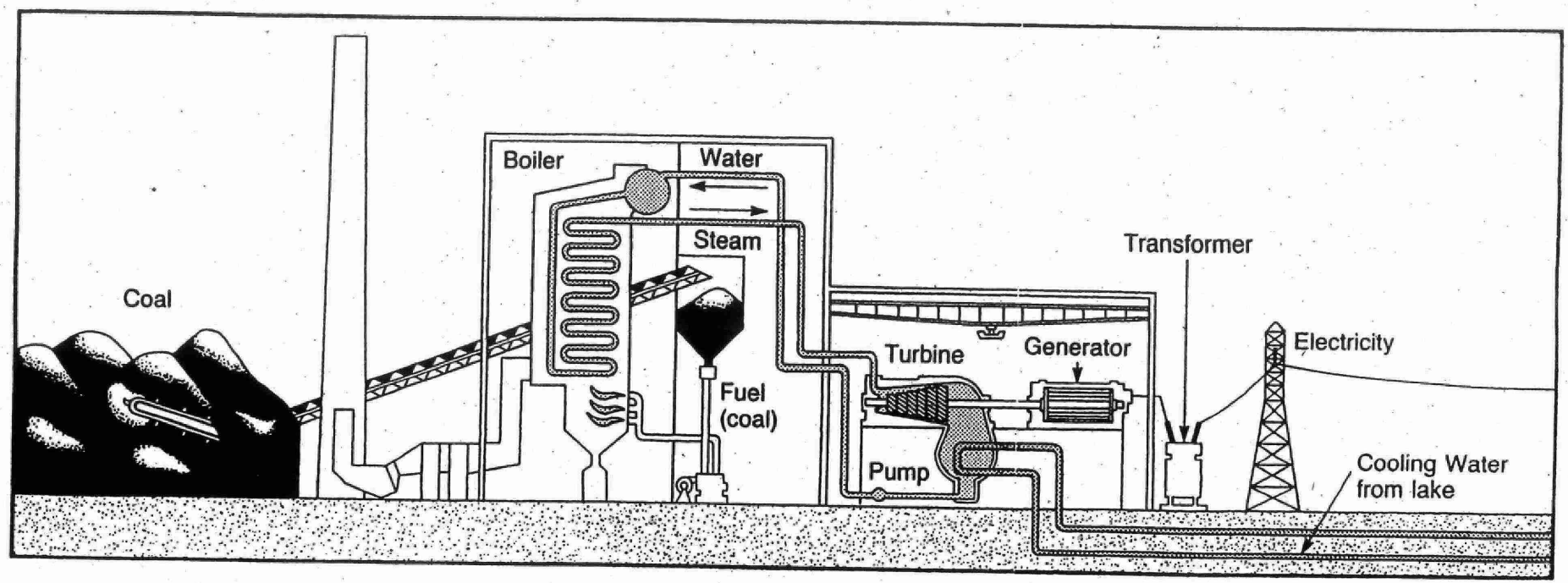


Figure 2.3
Cross Sectional View of a Typical
Fossil Thermal Generating Station

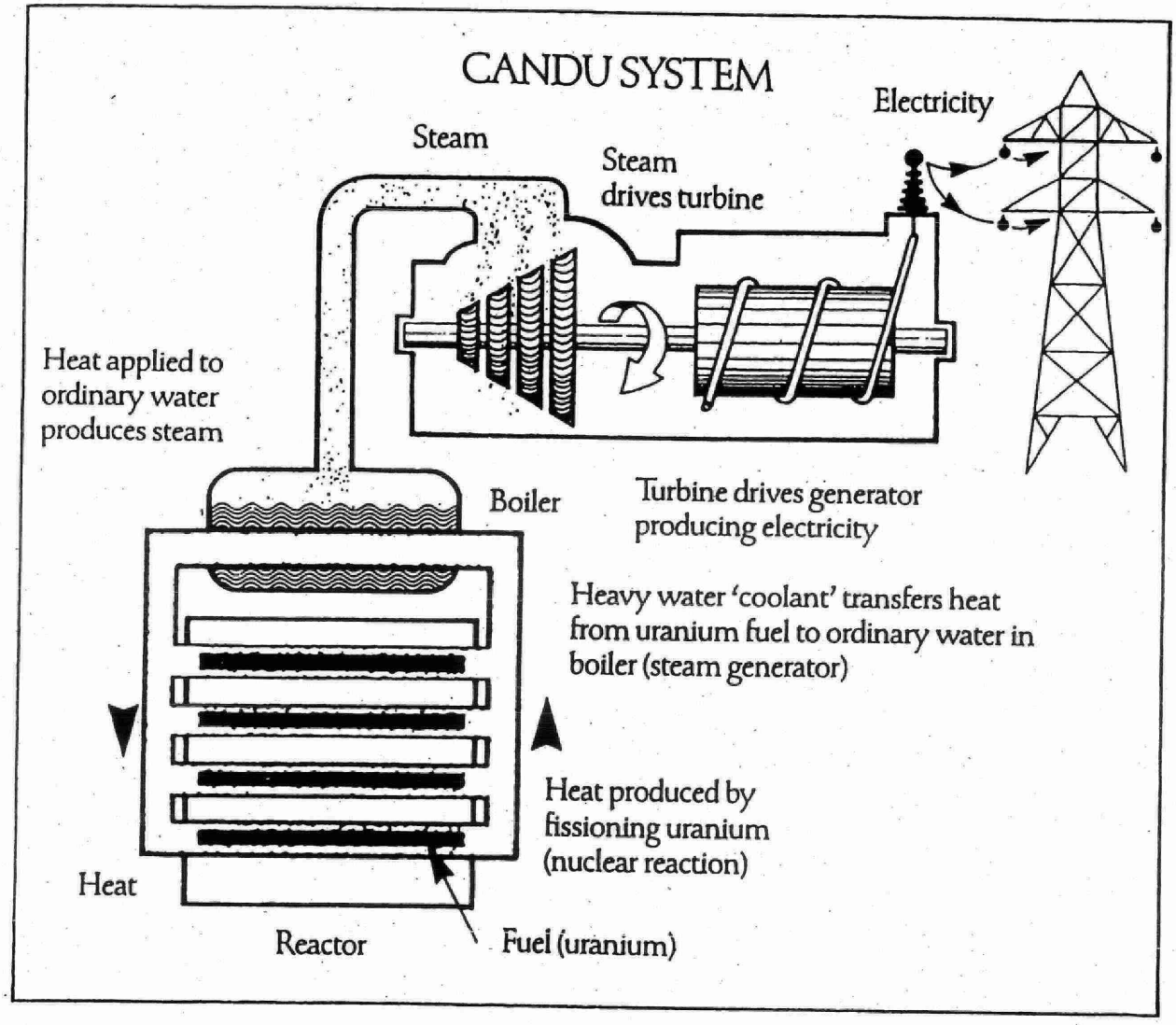
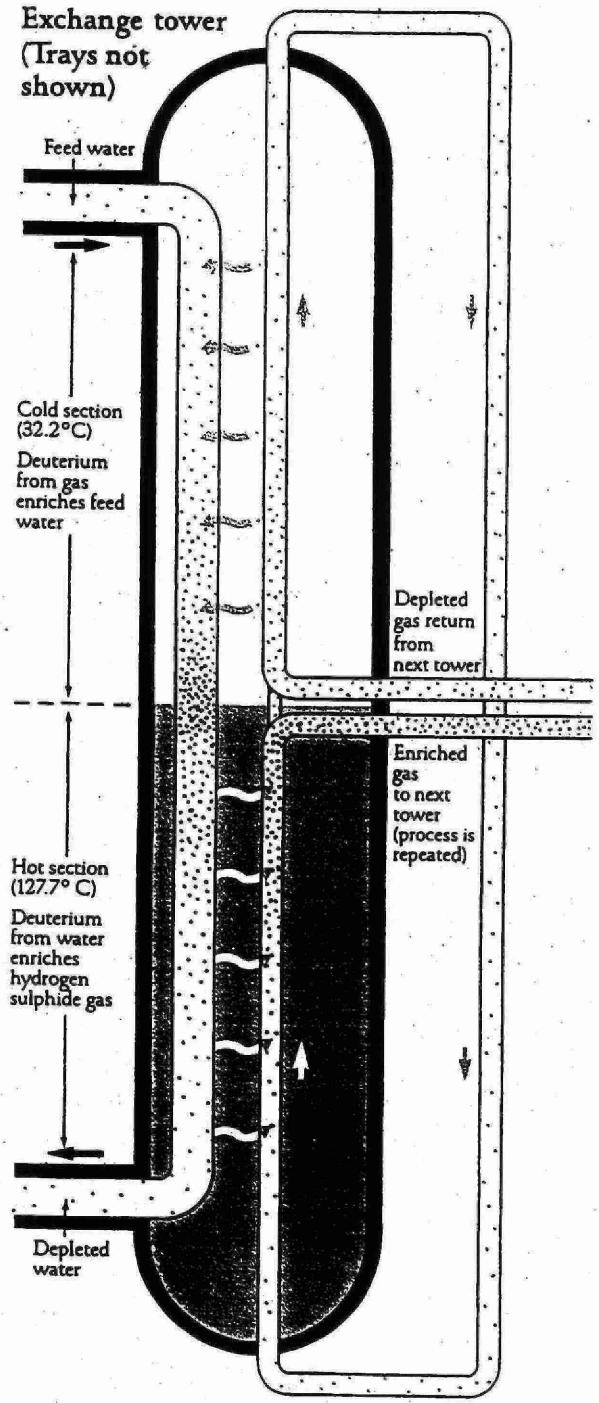


Figure 2.4
Cross Sectional View of a Typical
Nuclear Thermal Generating Station



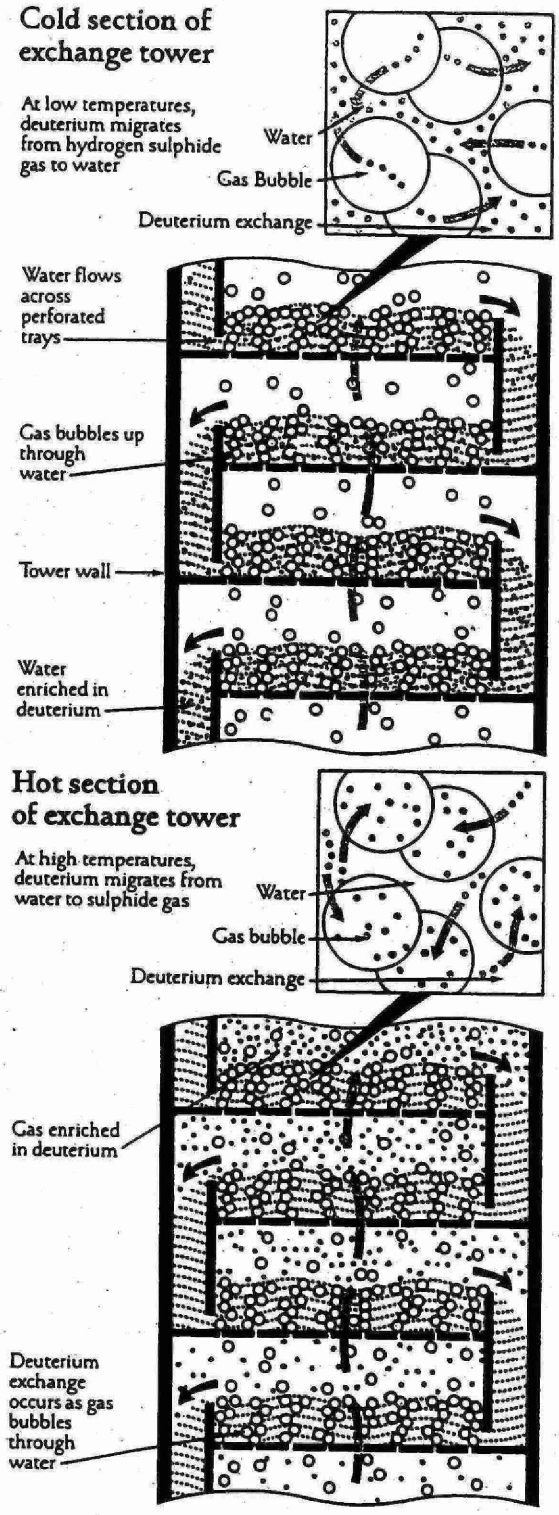


Figure 2.5
Bruce Heavy Water Plant
Heavy Water Production Process

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Section 3

Electric Power Generation Sector
Wastewater Effluent

Section 3
Wastewater Effluent

Contents

Section		Page
3.0	**Electric Power Generation Sector Wastewater Effluent**	1
3.1	**Effluent from Fossil and Nuclear Powered Generating Stations**	1
3.2	**Effluent Volumes - Fossil and Nuclear Stations**	2
3.3	**Effluent Types Specific to Fossil Stations**	4
	3.3.1 Ash Treatment System	4
	3.3.2 Coal Pile Effluent	7
	3.3.3 Emergency Overflow Effluent	8
3.4	**Effluent Types Specific to Nuclear Stations**	9
	3.4.1 Radioactive Liquid Waste Management System Effluent	9
3.5	**Effluent Types Common to Both Fossil and Nuclear Stations**	10
	3.5.1 Neutralization Sump Effluent	10
	3.5.2 Boiler Blowdown Effluent	15
	3.5.3 Oily Water Separator Effluent	17
	3.5.4 Equipment Cleaning Effluent	19
	3.5.5 Building Effluent	23
	3.5.6 Cooling Water Effluent	26
	3.5.7 Storm Water Effluent	27
3.6	**Effluent from Hydraulic Generating Stations**	27
Nuclear Support Facilities		28
3.7	**Bruce Heavy Water Plant (BHWP)**	28
	3.7.1 Effluent Volumes - BHWP	28
	3.7.2 Process Effluent	29
	3.7.3 Process Effluent Lagoons	29
	3.7.4 Building Effluent	30
	3.7.5 Surface Water Treatment Facility	31
	3.7.6 Cooling Water Effluent	32
	3.7.7 Storm Water Effluent	32
3.8	**Bruce Nuclear Power Development Services (BNPDS)**	33
	3.8.1 Effluent Volumes - BNPDS	33
	3.8.2 Bruce Bulk Steam System	34
	3.8.3 Steam Transformer Plant - A (STP-A)	34
	3.8.4 Steam Transformer Plant - O (STP-O)	35
	3.8.5 Sewage Treatment Plant	36
	3.8.6 Radioactive Waste Storage Site	37
	3.8.7 Chemical Waste Pond	37
	3.8.8 Cooling Water	38
	3.8.9 Storm Water	38

Section		Page
3.9	**Darlington Construction Site**	39
	3.9.1 Effluent Volumes - Darlington Construction Site	39
	3.9.2 Neutralization Sump	40
	3.9.3 Boiler Blowdown	40
	3.9.4 Equipment Cleaning Effluent	42
	3.9.5 Sewage Treatment Plant	43
	3.9.6 Waste Settlement Pond	44
	3.9.7 Cooling Water	44
	3.9.8 Storm Water	45
3.10	**Block Diagrams**	45
3.11	**References**	64

List of Tables

Table		Page
3.1	Power Generating Station Effluent Types	2
3.2	Fossil Stations Subcategory Average Effluent Flows	3
3.3	Nuclear Stations Subcategory Average Effluent Flows	3
3.4	Wastewaters Directed to the Ash Transport Water Treatment System	6
3.5	Generating Station Water Treatment Plant Chemicals	11
3.6	Generating Station Water Treatment Plant Waste Stream Configurations	12
3.7	Bulk Boiler Chemical Usage (1991)	16
3.8	Range of Effluent Volumes: Building Effluent - Fossil Stations	24
3.9	Range of Effluent Volumes: Building Effluent - Nuclear Stations	25
3.10	Bruce Heavy Water Plant (BHWP): Average Effluent Volumes	28
3.11	Bruce Heavy Water Plant (BHWP) Oil Emissions Rate	29
3.12	Bruce Nuclear Power Development Services (BNPDS): Average Effluent Volumes	33
3.13	BNPDS Chemical Waste Pond - Discharge Volumes	38
3.14	Darlington Construction Site: Average Effluent Volumes	39

List of Figures

Figure		Page
3.1	Atikokan TGS Baseline Process Flow Diagram	46
3.2	Lakeview TGS Baseline Process Flow Diagram	47
3.3	Lambton TGS Baseline Process Flow Diagram	48
3.4	Lennox TGS Baseline Process Flow Diagram	49
3.5	Nanticoke TGS Baseline Process Flow Diagram	50
3.6	Thunder Bay TGS Baseline Process Flow Diagram	51
3.7	J.C. Keith TGS Baseline Process Flow Diagram	52
3.8	R.L. Hearn TGS Baseline Process Flow Diagram	53

Figure	List of Figures (continued)	Page
3.9	Decew Falls HGS Baseline Process Flow Diagram	58
3.10	Pine Portage HGS Baseline Process Flow Diagram	59
3.11	Sir Adam Beck II HGS Baseline Process Flow Diagram	60
3.12	Bruce NGS - A Baseline Process Flow Diagram	54
3.13	Bruce NGS - B Baseline Process Flow Diagram	55
3.14	Darlington NGS Baseline Process Flow Diagram	56
3.15	Pickering NGS Baseline Process Flow Diagram	57
3.16	Bruce Heavy Water Plant Baseline Process Flow Diagram	61
3.17	Bruce Nuclear Power Development Services Baseline Process Flow Diagram	62
3.18	Darlington Construction Site Baseline Process Flow Diagram	63

3.0 Electric Power Generation Sector Wastewater Effluent

This section provides information on each effluent type sampled during the MISA monitoring period, including, wastewater volumes, wastewater sources, technologies in place and an overview of the analytical and toxicity data collected. An overview of the data is provided only to highlight the most obvious parameters contributed by the process and the expected sources of these parameters, if known. For each stream the number of parameters "found"[a] (excluding pH and conductivity) is indicated. Appendix B at the back of this document contains average concentration and loading data for all parameters "found" in effluents from the Electric Power Generation Sector during the MISA monitoring period. The reader should refer to these tables for the complete list of parameters found and the actual levels in each effluent. Appendix C contains a summary of all MISA toxicity test results[1,2]. Effluents specific to fossil fuelled stations are discussed under section 3.3 while effluents specific to nuclear stations are discussed under section 3.4. Effluents which are common to both fossil and nuclear stations are discussed together under section 3.5. Hydraulic stations are discussed under section 3.6. Each of the three facilities included in the nuclear associated facility category are unique; therefore, they are discussed separately under sections 3.7 through 3.9. Section 3.10 provides block diagrams for each site in the Electric Power Generation Sector (EPGS) showing treatment configurations existing during the MISA monitoring period and each sampling control point location.

3.1 Effluent from Fossil and Nuclear Power Generating Stations

Effluent types monitored at fossil and nuclear powered generating stations are listed below in table 3.1. Effluent streams are classified as process or non-process. A number of effluent types are common (eg. boiler blowdown) to both fossil and nuclear stations whereas other process effluent streams are specific to fossil (eg. ash transport water treatment system) or nuclear (radioactive liquid waste management system effluent) stations.

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[a] For each effluent stream, parameters defined as "found" are those detected at a concentration greater or equal to the regulation method detection limit in 10% (at a 95% confidence level) or more of the samples collected from the effluent during the MISA monitoring period.

Table 3.1
Power Generating Station Effluent Types

Process Effluent	Non-process Effluent
Effluent Types Common to Fossil And Nuclear Power Generation	
Neutralization Sump effluent (NS)	Condenser Cooling Water (CCW) effluent
Boiler Blowdown (BB) effluent	Service Cooling Water (CW) effluent
Oily Water (OW) Separator effluent	Building Effluent (BE)
Equipment Cleaning (EC) effluent	Storm Water (SW) effluent
Effluent Types Specific To Fossil Generated Power	
Ash Transport Water Treatment System (ATWTS) effluent	-
Coal Pile (CP) effluent	-
Emergency Overflow (EO) effluent	-
Effluent Types Specific to Nuclear Generated Power	
Radioactive Liquid Waste Management System (RLWMS) effluent	-

3.2 Effluent Volumes - Fossil and Nuclear Stations

Tables 3.2 and 3.3 provide average effluent discharge volumes for effluent streams monitored in the fossil station and nuclear station subcategories. Water usage is predominantly condenser cooling water; at fossil stations approximately 95% and at nuclear stations greater-than 99%. A number of effluent streams at fossil stations were monitored prior to treatment and/or combining with other effluent streams. This upstream monitoring was conducted to detect parameters, prior to dilution, which may not be removed through treatment in the existing systems. Most effluent streams at fossil stations are combined with condenser cooling water (CCW) prior to discharge (ie. all ash transport water treatment system effluent, neutralization sump effluent, emergency overflow effluent and building effluent). Other effluent streams, depending on the design of each station, discharge to the station intake channel or directly to receiving waters. At nuclear stations, all process effluent streams are combined with condenser cooling water prior to discharge to receiving waters.

Table 3.2
Fossil Stations Subcategory
Average Effluent Flows (LTA) - (June 1, 1990 to May 31, 1991)

	Station					
Effluent Description	Atikokan	Lakeview	Lambton	Lennox	Nanticoke	Thunder Bay
ATWTS, m^3/day	2,030	4,260	2,320	N.A.	44,065 *	2,650
Neutralization Sump, m^3/day	235	1,050 **	1,550 **	486	1,290 **	250
Coal Pile, m^3/event	11.7 (4)	2940 (14)	157 (248)	N.A.	39900 ** (10)	319 ** (365)
Oily Water Separator, m^3/day	1,210	45.6	N.A.	950	N.A.	180
Boiler Blowdown, m^3/day	87	1,914	1,252	1,160	379	63
Emergency Overflow, range of discharge volumes, m^3/discharge	82 - 3,816 (39)	1 - 790 (8)	1 - 480 (4)	no discharges	1 - 153 (4)	660 - 4,000 (3)
Equipment Cleaning, range of discharge volumes, m^3/discharge	no discharges	700 - 4,450 (3)	1,302 - 34,630 (4)	no discharges	77 - 73,000 (18)	no discharges
Building Effluent, m^3/day	N/A	259,000 †	60,000 †	59,200 †	330,500 †	N/A
Transformer Cooling Water, m^3/day	N/A	N/A	5,090	16,000	N/A	N/A
Condenser Cooling Water, m^3/day	476,000	4,210,000	2,320,000	1,870,000	5,330,000	939,000

Table 3.3
Nuclear Stations Subcategory
Average Effluent Flows (LTA) - (June 1, 1990 to May 31, 1991)

	Station			
Effluent Description	Bruce - A	Bruce - B	Darlington	Pickering
Neutralization Sump Effluent, m^3/day	880	563	320 †	972
Radioactive Liquid Waste Management, m^3/day	174	78	84	429
Boiler Blowdown, m^3/day	1,908	5,040	468	2,058
Equipment Cleaning, range of discharge volumes, m^3/discharge	no discharges	110 - 200 (6)	112 (31)	1 - 200 (5)
Building Effluent, m^3/day	71 †	439 †	43	6,222 †
Oily Water Separator, m^3/discharge	N.A.	N.A.	14 - 57 (10)	1 (9)
Cooling Water ††, m^3/day	10,300,000	14,600,000	4,510,000	18,017,650

Notes for Table 3.2 and Table 3.3

* = includes intermittent flushing of ash lines at Nanticoke (average volume = 1170 m^3/day)

** = monitored upstream of Ash Transport Water Treatment System (ATWTS)

† = flow revised after MISA monitoring period

†† = includes CCW and service waters

Number of discharge volumes reported are indicated in brackets for all intermittent streams. All other effluent streams are discharged daily.

N.A. = Not Applicable

Boiler blowdown and building effluents are the sum of all streams monitored at each station.

3.3 Effluent Types Specific to Fossil Stations

3.3.1 Ash Transport System

Ash generated from combustion is of two types; 1.) fly ash and 2.) bottom ash.

1.) Fly Ash: Fine particles of ash carried in the flue gas leaving the boilers is called fly ash. Depending on the grade of coal, fly ash accounts for approximately 70 to 85% of the total quantity of ash produced. Up to 99% of fly ash is collected into bins by passing flue gasses through electrostatic precipitators (EPs) before flue gasses are released to the atmosphere. At all stations except Nanticoke, fly ash is trucked to a disposal site or to an industrial buyer. During the MISA monitoring period, unlike other fossil stations, fly ash at Nanticoke was sluiced from the EP bins to lagoons for treatment along with bottom ash. This "wet" fly ash system at Nanticoke has been recently changed to a "dry" system which is similar to other fossil stations. Dry fly ash systems use air, rather than water, to transport fly ash from EP bins to temporary storage. Conversion to a dry fly ash system has substantially reduced the volume of water and loadings treated in the ash lagoons. Average effluent volume from the lagoons measured over the period January to May 1993 was 14,534 m^3/day in comparison to a flow of 42,900 m^3/day measured during the MISA monitoring period. With the dry system, the average TSS concentration in effluent from the lagoons (5.5 mg/L) is also lower than the average concentration measured during the MISA monitoring period (17.2 mg/L).

Residual (Bunker C) oil burned at Lennox produces a very small amount of fly ash in comparison to coal. It is collected using electrostatic precipitators, packed into drums and sold or shipped for secure disposal.

2.) Bottom Ash: Ash which falls to the base of the boiler is called bottom ash. Bottom ash is collected in hoppers at the base of each boiler after which it is handled differently depending on the design of each station. Differences in the method of handling and treating bottom ash at each coal fired station are described below.

Sluiced Bottom Ash: At Lakeview, Lambton and Thunder Bay, bottom ash is sluiced, with water, out of the furnace hopper to dewatering bins where settleable ash is collected for trucking and disposal. At Lakeview and Lambton, overflow from the dewatering bins is directed to settling ponds and then to a filter plant. Chemicals are not added to promote settling. Overflow from the dewatering bins at Thunder Bay is treated using

gravity clarification and filtration with the addition of polyelectrolytes to promote flocculation. At each of the above stations, effluent from the pyrites removal system is also sluiced to the ash treatment system. Pyrite is hard/coarse material (iron sulphide) which is separated from the coal during the pulverizing process.

On occasions, due to filter plant outage or tank cleaning which causes a reduction in capacity, there is an overflow that bypasses the ash filtration plant to the outfall. Overflows from the settling tanks occurred at Lakeview and Lambton during the MISA monitoring period and were monitored as emergency overflow effluent streams.

Submerged Scraper Conveyor System: At Atikokan, bottom ash is removed from the furnace in a dewatered condition by a submerged scraper conveyor to a furnace ash storage room for disposal by truck. Overflow (quench/seal water) from the ash hopper is directed to a collection sump which also receives drainage from other systems producing wastewaters contaminated with solids. Effluent from the collection sump feeds the ash treatment system which consists of clarification and filtration. A number of overflows from the collection sump occurred during the MISA monitoring period which were sampled under the classification of emergency overflow effluent. Pyrites separated out in the coal pulverizers are also transported to the furnace ash storage room using the submerged scraper conveyor.

Sluiced Bottom Ash and Fly Ash: At Nanticoke TGS, during the MISA monitoring period, both bottom ash and fly ash were sluiced to ash lagoons. The ash lagoons consist of a series of four lagoons where ash is allowed to settle by gravity. Ash is sluiced to the lagoons in a separate line from each boiler. The lines are periodically flushed to the ash lagoons to prevent accumulation of solids. During winter the lines must be drained after flushing to prevent freezing. This flushing/drainage water was monitored at control point 0300 prior to discharge to yard drains.

At Lennox Generating Station, residual (Bunker C) oil is burned. In comparison to coal, oil produces a very small amount of bottom ash which is collected dry directly from the ash hopper into drums for sale or disposal.

Although the primary purpose of the ash transport water treatment system is to receive boiler ash, other solids contaminated streams are also directed to the ash transport water treatment system which vary depending on the design of each station. The primary streams directed to the ash treatment system are listed in Table 3.4 for each station.

Table 3.4
Wastewaters Directed to the Ash Transport Water Treatment System

Station	Wastewater Source
Atikokan	• boiler quench/seal water • air preheater washes • boiler internal washdowns • WTP clarifier underflow • powerhouse drains susceptible to solids contamination
Lakeview	• air preheater washes • neutralization sump effluent
Lambton	• neutralization sump effluent • surface runoff from area around ash silos
Lennox	• no ash treatment system at Lennox
Nanticoke	• fly ash • neutralization sump effluent • boiler acid wash • coal pile runoff • air preheater wash • runoff from the ash storage area
Thunder Bay	• boiler quench/seal water • WTP clarifier underflow, filter (sand/carbon) backwash • floor drains potentially contaminated with solids, • coal pile runoff, • internal wash down of boilers during maintenance, • fly ash conditioning (dust suppressant) water, • powerhouse drainage sump: collects water from the boiler-side powerhouse floor drains (receives wastewater from external equipment washings - various overflow streams and/or spills could also be discharged to this sump

Effluent from the bottom ash transport water treatment system at each coal fired station was monitored under the MISA monitoring regulation.

MISA Monitoring Data on Ash Transport Water Treatment Systems

Analytical: A summary of average concentration and loading data for all parameters found in effluent from ash transport water treatment systems is provided in tables 1 and 2 of appendix B at the back of this document. Thirty-three parameters were found in effluent from ash treatment systems. Concentrations of TSS were highest at Lakeview and Nanticoke (avg. = 14 and 17 mg/L respectively). Average TSS levels in ATWTS effluent from the other three stations were approximately 11 mg/L. Metals found at

the highest concentrations included aluminum, boron, iron and strontium. Higher levels of boron, lithium, molybdenum, strontium, vanadium and selenium were found in effluent from Nanticoke because of the greater soluble metal content of fly ash. Ammonia levels were also higher at Nanticoke because, as of November 1990, ammonia was injected into the flue gasses to improve fly ash collection efficiency when burning low sulphur coals. pH was also typically elevated at Nanticoke (avg. = 10.7). The average concentration of phosphorus at Lambton (2.3 mg/L) is skewed by one high outlier (113 mg/L).

Toxicity: Samples from Nanticoke were toxic to both Daphnia magna and rainbow trout in ten of twelve samples. Possible causes for toxicity are pH > 9 together with ammonia, aluminum, strontium and selenium. Two of twelve samples from Atikokan were toxic to Daphnia magna only. All samples from Lakeview, Lambton and Thunder Bay were non-toxic. A summary of toxicity test results is provided in table 1 of appendix C.

3.3.2 Coal Pile Effluent

Precipitation runoff from coal piles may contain elevated levels of suspended solids due to coal dust and also oil & grease because waste oil is sprayed on coal piles as a dust suppressant. Runoff from coal pile storage areas is collected at all sites except Atikokan.

At Atikokan, coal pile runoff is collected in ditches which drain to a former mine waste pond which has no discharge. Runoff collected in the ditching was monitored at control point 0400.

At Thunder Bay and Nanticoke, coal pile runoff is directed to the ash transport water treatment system and was monitored upstream of the ash transport water treatment system.

At Lakeview, runoff from the coal pile is directed to a two cell coal pile drainage pond. Untreated influent to the pond passes through a sump (control point 1700) where lime can be added to raise the pH. The contents of the pond can be recirculated through the sump. Some water from the pond is sprayed on the coal pile as a dust suppressant . During periods of heavy rainfall the pond can discharged through control point 1800 to the intake channel in order to prevent a back-up in ditching which could cause an untreated overflow (ctrlpt. 2200) to enter Lake Ontario. Any overflows were monitored as an emergency overflow effluent.

At Lambton coal pile effluent and ash pile drainage is directed to a man-made lake (Lake Lambton: approximately 3

metres deep and 14.3 ha in area). Sodium hydroxide is added, if required, to promote precipitation of metals.

MISA Monitoring Data on Coal Pile Effluent

Analytical: Average concentrations and loadings for all parameters found in coal pile effluent are provided in tables 3 and 4 of appendix B. Twenty-seven parameters were found in coal pile effluent. Parameters found at the highest concentrations and/or loadings were total suspended solids, aluminum, boron, iron, strontium and oil & grease. Discharge volumes from Atikokan are low (12 m^3/discharge, 4 discharges); therefore, the loadings are also low. Only data from Lakeview (1800) and Lambton (1100) represent levels of contaminants discharged directly to receiving waters. Data from coal pile effluent at Nanticoke and Thunder Bay represent contaminant levels prior to receiving treatment in the ash transport water treatment system.

Toxicity: Toxicity testing was conducted only at Lakeview and Lambton because other sites route coal pile effluent for co-treatment with bottom ash. Only one sample from Lakeview was toxic to rainbow trout. None were toxic to Daphnia magna. All samples from Lambton were non-toxic. A summary of toxicity test results is provided in table 1 of appendix C.

3.3.3 Emergency Overflow Effluent

Effluent streams monitored under the classification of emergency overflow effluent include overflows from various sumps and tanks. Overflow from each of these systems will discharge untreated wastewater to clean drains. Monitoring was required during each discharge. The following overflows discharged during the MISA monitoring period.

Station	Control Point	Emergency Overflow Effluent
Atikokan	0500	ash transport water treatment system collection sump
	1300	WTP/ash transport water treatment system sludge sump
Lakeview	2100	ash filtration plant east
	2200	coal pile drainage pond
	3900	ash filtration plant west
Lambton	0300	ash settling tanks
Nanticoke	2400	neutralization sump
Thunder Bay	1000	ash transport water treatment system surge tanks

MISA Monitoring Data on Emergency Overflow Effluent

Analytical: A summary of average concentration and loading data for all parameters found in emergency overflow effluent is provided in table 40 of appendix B. Parameters found at the highest concentrations in overflows from the ash treatment system and neutralization sump were total suspended solids and iron. Zinc was found at high concentrations (3.7 and 2.9 mg/L) in two of the four overflows monitored from the ash settling tanks at Lambton. Parameters found at highest concentrations in overflow from the coal pile drainage pond system at Lakeview were total suspended solids, TOC, zinc, iron and oil & grease.

Toxicity: Toxicity testing was not conducted on emergency overflow effluent. Under the effluent limits regulation the discharge of these streams will be prohibited.

3.4 Effluent Types Specific to Nuclear Stations

3.4.1 Radioactive Liquid Waste Management System (RLWMS):

Each nuclear station has a radioactive liquid waste management system (RLWMS) whose purpose is to receive drainage from all areas of the station which may contain radioactivity. Wastewater is monitored and discharged to the CCW outfall if radioactivity criteria set by the Federal Atomic Energy Control Board (AECB) is met. RLWMS wastewater with radioactivity levels higher than permitted by the AECB can be treated by filtration and ion exchange and/or transferred to hold-up tanks to allow for decay before being discharged to the environment.

Radioactive effluent is comprised primarily of water collected in sumps from the radioactive area floor drain system, equipment sumps and from the cleaning of contaminated equipment. Effluent from laboratory drains, laundry facilities, mechanical maintenance shops and parts washers are also directed to the RLWM system. Wastewaters from an upstream oil/water separator at both Bruce-A and Bruce-B are also directed to the RLWM system.

MISA Monitoring Data on RLWMS Effluent:

Analytical: A summary of average concentration and loading data for all parameters found in effluent from RLWM systems is provided in tables 16 and 17 of appendix B. Thirty-five parameters were found in RLWMS effluent. Average concentrations of phosphorus were greater than 1 mg/L at all stations (average

of 4 mg/L at Bruce-A). Phosphorus loadings were less than 1 kg/day at all stations. Total suspended solids levels were highest at Darlington (avg. = 40 mg/L) while TSS levels averaged 7 - 10 mg/L at other stations. Concentrations of metals were also higher at Darlington. The higher aluminum levels are probably due to aluminum silicates from recently poured concrete. The only expected source of iron, zinc and copper is corrosion. Sulphide found in RLWMS effluent from Bruce-A may come from sludge at the bottom of the holding tanks[23] where sulphate can be reduced to sulphide by anaerobic bacterial activity; however, sulphide was also found in Bruce-A intake waters at similar concentrations. Methylene chloride was found at three stations and mercury at two stations. The expected source for both of these parameters are laboratory sinks which discharge to the RLWMS at each station. Methylene chloride is a common laboratory solvent and mercury is used in Nessler's reagent for the analysis of ammonia. Tetrachloroethylene found at Bruce-A is used in parts washers in the mechanical maintenance shop. Concentrations of oil & grease are higher at Pickering because of the hydraulic (oil) refuelling machines employed at this station. Refuelling machines at the other stations are driven by water. PCBs were found in RLWMS effluent at Bruce-A and Pickering. The source of PCBs is thought to be residual contamination left during the commissioning stages of these older stations. Octachlorodibenzo-p-dioxin was found in effluent at Darlington and at lower levels at Pickering.

Toxicity: Approximately 25% - 35% of the RLWM samples from Bruce-A, Darlington, and Pickering were toxic to both Daphnia magna and rainbow trout. Bruce-B RLWMS effluent was toxic only to Daphnia magna (2 out of 12 samples). Insufficient chemistry data exists to explain the toxicity of some samples. Causes for toxicity for samples with complete chemistry data is attributed to high concentrations of copper, zinc and ammonia. A summary of toxicity results for radioactive liquid waste management system effluent is provided in table 2 of appendix C.

3.5 Effluent Types Common to Both Fossil and Nuclear Stations

3.5.1 WTP Neutralization Sump Effluent:

Each generating station has a water treatment plant (WTP) for producing the high quality boiler feed water required for steam generation. Treatment operations include clarification, filtration and ion-exchange at all stations except at Bruce-A which has no clarifier. Chemicals used at each WTP during the MISA monitoring period to promote treatment are listed in Table 3.5.

Table 3.5
Power Generating Station Water Treatment Plant Chemicals[15]
(MISA Monitoring Period)

Chemical	Use	Fossil Station	Nuclear Station
Sodium Hydroxide, NaOH	Regeneration of anion exchange resins	All stations	All stations
Sulphuric Acid, H_2SO_4	Regeneration of cation exchange resins	All stations	All stations
Brine	Regeneration of cation exchange resins	Atikokan Thunder Bay	not used
Chlorine	Biocide	All Fossil Stations	Bruce - A Bruce - B Darlington
Ferric Sulphate	coagulant in clarifier	Lambton Lennox	not used
Alum, $Al_2(SO_4)_3$	coagulant in clarifier	Atikokan Thunder Bay	Bruce - B
Lime, $Ca(OH)_2$	softener in clarifier	Lakeview Lambton Nanticoke Lennox	Darlington Pickering
Poly-aluminum chloride	coagulant in clarifier	Lakeview	Darlington Pickering
Other Polyelectrolyte	coagulant in clarifier/ coagulant prior to filtration	Nanticoke Thunder Bay Lennox	Bruce - A Bruce - B

At all stations except Lennox TGS, wastewater from the WTP was monitored at the discharge from the neutralization sump. The purpose of the neutralization sump is to provide equalization volume for neutralization of acid and base waste streams resulting from regeneration of ion-exchange resins. Depending on the station design, the neutralization sump may also receive backwash from filters and clarifier underflow. At fossil stations, drains from the chemistry laboratories also discharge to the neutralization sump.

The flow path for WTP wastewater streams at each generating station are summarized in table 3.6 below.

At Lennox, all WTP waste streams are directed to the neutralization sump which discharges through a primary and secondary settling pond. WTP wastewaters at Lennox were

monitored at the discharge from the secondary settling pond.

A number of neutralization sump overflows occurred at Nanticoke during the MISA monitoring period and were monitored as emergency overflow effluent.

Table 3.6
Generating Station Water Treatment Plant Waste Stream Configurations

Station	Clarifier Underflow	Sand Filter Backwash	Carbon Filter Backwash	Neutralization Sump Effluent
Atikokan TGS	to sludge sump to ash treatment system	recycle to clarifier via backwash sump	recycle to clarifier via backwash sump	effluent to MISA monitoring point/ to CCW outfall.
Lakeview TGS	to neutralization sump	to neutralization sump	to neutralization sump	effluent to pH control/ to MISA monitoring point/ to ash settling tanks/ to ash filtration plant
Lambton TGS	to neutralization sump	to neutralization sump	to neutralization sump	effluent to MISA monitoring point/ to bottom ash settling ponds/ to ash filtration plant
Lennox TGS	to neutralization sump	to neutralization sump	to neutralization sump	effluent to settling ponds/to MISA monitoring point/to East yard drains/to lake Ontario
Nanticoke TGS	to neutralization sump	to neutralization sump	to neutralization sump	effluent to MISA monitoring point/ to ash lagoons
Thunder Bay TGS	to sludge sump to ash treatment system	to recycle sump to sludge sump to ash treatment system	to recycle sump to sludge sump to ash treatment system	effluent to MISA monitoring point/ to CCW outfall
Bruce NGS - A	no clarifier	to CCW	to CCW	effluent to MISA monitoring point/ to CCW outfall
Bruce NGS - B	to neutralization sump	recycle to clarifier	no carbon filter	effluent to pH adjustment/ to MISA monitoring point/ to CCW outfall

Table 3.6 (continued)
Generating Station Water Treatment Plant Waste Stream Configurations

Station	Clarifier Underflow	Sand Filter Backwash	Carbon Filter Backwash	Neutralization Sump Effluent
Darlington NGS	to thickener/ dewatering/ landfill. recycle filtrate to clarifier	recycle to clarifier	to neutralization sump	effluent to MISA monitoring point/ to CCW outfall
Pickering NGS - A&B	to settling pond/ dewatering/ landfill. overflow to neutralization sump	to neutralization sump	to neutralization sump	effluent to MISA monitoring point/ to CCW outfall

MISA Monitoring Data on Neutralization Sump Effluent

Analytical: A summary of average concentration and loading data for all parameters found in effluent from neutralization sumps at fossil stations are provided in tables 7 and 8 of appendix B. Data for nuclear stations are provided in tables 18 and 19. Twenty-seven parameters were found in neutralization sump effluent at fossil stations and twenty-six parameters at nuclear stations. Data for Atikokan, Lennox, Thunder Bay and all nuclear stations represent contaminants which are released directly to receiving waters. At Lakeview, Lambton and Nanticoke neutralization sump effluent is directed to the ash treatment system; therefore, data collected for these sites represents levels of contaminants prior to receiving final treatment.

The pH of neutralization sump effluent is variable due to the regeneration of resins with acid and caustic. Of the direct discharging neutralization sumps, levels of TSS were highest at Bruce-B (avg. = 147 mg/L). During the MISA monitoring period, the neutralization sump at Bruce-B received both filter backwash and clarifier underflow and discharged without treatment. A new Bruce-B WTP was commissioned in January, 1994 which directs filter backwash and clarifier underflow to a thickener.

Metals found in neutralization sump effluent can result from:

- concentrating of metals on ion exchange resins or filtered particulate from intake water,
- impurities in regenerant chemicals (mercury),
- corrosion of chemical storage vessels,
- treatment chemicals.

As expected, aluminum concentrations were highest at those stations using water treatment chemicals containing aluminum.

Chloroform and other trihalomethanes (THMs) are formed during the chlorination of intake water. THMs were the only organics detected consistently in neutralization sump effluent. Intake waters are chlorinated during summer months for prevention of zebra mussel infestation and resin biofouling. Chlorination is limited only to the amount necessary because chlorinated organics thermally decompose to produce corrosive chloride ions in boilers. Phenolics (4AAP) was found at an average of 68 mg/L at Atikokan and 34 mg/L at Thunder Bay. Intake waters at both of these stations had an average phenolics concentration of 47 mg/L.

Toxicity: Only those stations with neutralization sump effluent discharged directly to receiving waters were tested for toxicity (ie. Atikokan, Lennox, Thunder Bay and all nuclear stations).

Neutralization sump effluent from Bruce-A, Darlington and Thunder Bay were the most toxic effluent streams in the sector.

Toxicity - Fossil: Neutralization sump effluent at Thunder Bay was consistently toxic to both rainbow trout and Daphnia magna. Samples from Thunder Bay had extremes in pH (>10.5 to <2.3). Copper, aluminum and strontium were also identified as possible contributors to the toxicity of this effluent. Samples from Atikokan were infrequently toxic to rainbow trout and Daphnia magna. Samples from Lennox were non-toxic. A summary of toxicity test results is provided in table 1 of appendix C.

Toxicity - Nuclear: Neutralization sump effluent at Bruce-A and Darlington were consistently toxic to both rainbow trout and Daphnia magna. Causes for toxicity appears to be primarily pH related. The pH of neutralization sump effluent from these sites is frequently <3. High concentrations of total suspended solids and moderate concentrations of copper, zinc and aluminum have also been identified as possible contributors to the toxicity of these streams. Samples from Bruce-B and Pickering were infrequently toxic to both rainbow trout and Daphnia magna. Only one sample from Pickering was found toxic. The pH of this sample was <2.3. Two samples from Bruce-B were toxic to Daphnia magna only. The pH of these samples was approximately 5 and aluminum concentrations exceeded 30 mg/L. A summary of toxicity test results is provided in table 2 of appendix C.

3.5.2 Boiler Blowdown Effluent:

Boiler blowdown occurs for both operating control and maintenance of boiler water chemistry. In either case, some of the boiler water is drained from the steam drum and discharged either to the forebay or to the CCW outfall, depending on the station.

During normal operation, the steam drum water level must be maintained at a specified level (this is an indication of the pressure in the steam drum). At the time of boiler startup, thermal expansion increases the volume of water in the boiler; therefore, operators must drain water through blowdown in order to maintain the appropriate steam drum water level. Blowdown for operational reasons occurs primarily at fossil stations due the more frequent boiler start ups.

Boiler blowdown is required to maintain boiler water chemistry because operation of a boiler eventually results in the build-up of impurities in the steam drum. To prevent the concentration of impurities from becoming too high a portion of the boiler water is released (blowdown) either continuously or intermittently and replaced by an equivalent quantity of high quality water from the water treatment plant. The addition of boiler makeup water allows the reduction of undesirable chemical content. Blow down rates vary depending on the rate of build-up of impurities which, in turn, depends on the quality of boiler feed water, in-leakage at the condenser, the amount of corrosion and quantities of chemicals added for control of corrosion and scaling. Boiler water quality is monitored on a regular basis and boiler blowdown is conducted manually as required.

Treatment chemicals are added to the boiler system to reduce corrosion and scaling. Phosphate is used at all fossil stations to control scaling; however, it is not used at nuclear stations. Hydrazine is used at all fossil and nuclear stations to consume oxygen. At Bruce-B and Darlington where the steam/feed water system is constructed from ferrous metal, pH of boiler water is controlled using ammonia. At Pickering and Bruce-A, where some heat exchangers contain brass tubes, morpholine is used for pH control because ammonia causes corrosion of copper. All fossil stations use ammonia for pH control. Morpholine is not used because it breaks down to form corrosive organic acids at the higher operating temperatures of fossil boilers. Table 3.7 provides usage of boiler treatment chemicals for 1991.

Table 3.7
Bulk Boiler Chemical Usage, kg (1991)[7]

Station	Hydrazine	Ammonia	Morpholine	Phosphate
Atikokan	N/A	N/A	not used	N/A
Lakeview	N/A	N/A	not used	N/A
Lambton	N/A	N/A	not used	N/A
Lennox	N/A	N/A	not used	N/A
Nanticoke	N/A	N/A	not used	N/A
Thunder Bay	N/A	N/A	not used	N/A
Bruce-A	4,054	not used	11,659	not used
Bruce-B	5,757	2,490	3,747	not used
Darlington	7,097	1,909	not used	not used
Pickering	4,900	not used	5,678	not used

MISA Monitoring Data on Boiler Blowdown Effluent

Analytical: A summary of average concentrations for all parameters found in boiler blowdown effluent is provided in table 33 of appendix B. MISA monitoring data indicate that boiler blowdown is generally of high quality. With the exception of added treatment chemicals, levels of contaminants are often lower than intake water. Fourteen parameters were found in boiler blowdown effluent from fossil stations, twelve parameters were found in boiler blowdown effluent from nuclear stations. Parameters found at highest concentrations included ammonia+ammonium and total Kjeldahl nitrogen at all generating stations and phosphorus at all fossil stations (particularly Lambton). pH is also typically elevated (ie. >8.5) at all stations. Copper was found at elevated levels in three of eight boilers monitored at Nanticoke (average concentrations 282, 711, 3117 ug/L).

Toxicity: Boiler blowdown effluent streams from all fossil stations were consistently toxic to Daphnia magna and frequently toxic to rainbow trout. Toxicity of boiler blowdown effluents from nuclear stations varied. Boiler blowdown effluent at Pickering was consistently toxic to rainbow trout and Daphnia magna. In contrast, boiler blowdown at Bruce-B was relatively non-toxic with only one sample lethal to Daphnia and none lethal to trout. MISA analytical data indicate that the toxicity of boiler blowdown effluent is due to combinations of factors including low ionic strength (ie. low conductivity), pH >9, free

ammonia >100 ug/L and elevated levels of copper and zinc. A summary of toxicity test results for boiler blowdown at fossil stations is provided in table 1 of appendix C. Results from nuclear stations are contained in table 2.

3.5.3 Oily Water Separator Effluent

Oil and grease, from potentially or always oily areas of generating stations, is contained using dikes, blocking floor drains, inspecting sumps before pumpout or directing oily drainage to an oily water treatment system depending on design differences at each station. Oily water treatment systems monitored at each station are described below.

Fossil Stations: At Atikokan, Thunder Bay, Lakeview and Lennox, floor drains where the potential for oil contamination exists are separated from the normal floor drain system and routed to an oily water treatment system. Tilted plate separators are used at Thunder Bay (1) and Lakeview (2). At Atikokan, oil is separated by holding drainage in a large quiescent tank and skimming surface oil to an oil holding sump. Cooling water from oil coolers is also processed through the oily water treatment system at Atikokan. At Lennox, oily drainage from the boilerhouse is treated by an American Petroleum Institute (API) type oil water separator and then by dissolved air flotation (DAF). Treated effluent is directed to a holding pond for analysis and can be recycled if levels exceed limits. Storm water from the oil storage tanks area is also routed to the oily water treatment system at Lennox.

The water phase from oily water treatment systems is discharged to the CCW. At coal fired stations, recovered oil is sprayed on the coal pile as dust suppressant.

Nuclear Stations: Each nuclear station has an oily water treatment system for processing drainage contaminated with oil; however, the location and application of the treatment systems differ depending on the design of each station. All systems include a phase separation tank(s) and granular activated carbon filters.

Oily water separators are installed at Pickering NGS A&B to provide treatment of drainage from the transformer areas and oil tank farms. Water from these areas is due primarily to precipitation runoff. Runoff is retained in a diked area and drained through the oily water treatment system to the CCW whenever the area is full.

At Darlington NGS, effluent from areas most susceptible to oil contamination, with the exception of the switch yard, are directed to the oily water collection system. Areas of collection include inactive floor drains potentially contaminated with oil, tank farm diked areas, transformer pits, standby diesel generator areas (emergency power), and turbine hall lube oil processing areas. The treatment system includes O/W separation, polyurethane (1) and carbon (2) filters. During the MISA monitoring period the polyurethane and granular carbon filters of this treatment system were not commissioned; therefore, the data collected are based on a system used a large holding pond and phase separation facility. Oil that accumulated above the water surface was drawn off for disposal using "sucker trucks" as required. This is a batch release system and because effluent is collected from potentially oily areas within the station and outdoors, the volumes are sensitive to precipitation. Monthly monitoring of this effluent was required under the MISA monitoring regulation. MISA data indicate an average discharge volume of 27 m^3. Station data (1992/93) shows the discharge of nominal 40 m^3 batches about twice per month.

At Bruce-A and Bruce-B, O/W treatment systems are available to process oil contaminated water collected from almost any area of the station. Oily waste is pumped/drained into drums and transported to the O/W separator. The water phase is discharged to the RLWM system because water collected from a radioactive area of the station may contain tritium.

MISA Monitoring Data on Oil/Water Separator Effluent:

Analytical: A summary of average concentration and loading data for all parameters found in oily water separator effluent at fossil stations is provided in tables 5 and 6 of appendix B. Concentration data for oily water separator effluent from nuclear stations is provided in table 20.
Twenty-four parameters were found in effluent from oily water separators at fossil stations and twenty-three parameters at nuclear stations. The average oil & grease concentrations was highest at Lakeview (ctrlpt 2300, avg. = 13 mg/L). Phenolics (4AAP) was found at an average of 58 mg/L at Atikokan and 43 mg/L at Thunder Bay. Intake waters at both of these stations had an average phenolics concentration of 47 mg/L.

Toxicity:
Fossil: All samples from Atikokan, Lennox and Thunder Bay were non-toxic. Only one of twenty-three samples from Lakeview were toxic to rainbow trout. Five of twenty-three were toxic to Daphnia magna. A summary of toxicity test results is provided in table 1 of appendix C.

Nuclear: Only stations with direct discharging oily water separator effluent streams (ie. Darlington and Pickering) were sampled for toxicity. Samples from Darlington were toxic to trout in three out of twelve samples and toxic to Daphnia magna in four out of twelve samples. These samples had pH >8 and high concentrations of zinc an oil & grease. Samples from Pickering were infrequently toxic -- to trout in one out of twenty-one samples and to Daphnia magna in one out of twenty-one samples. A summary of toxicity test results is provided in table 2 of appendix C.

3.5.4 Equipment Cleaning Effluent

Wastewaters monitored at fossil stations under the classification of equipment cleaning effluent include boiler acid washes, air preheater washes and boiler external washes. Up to the end of MISA monitoring, a boiler cleaning had not been conducted at a nuclear station. Nuclear powered stations do not have air preheaters. Wastewaters monitored under the classification of equipment cleaning effluent at nuclear stations included boiler layup at Pickering and Bruce-B and heating steam condensate at Darlington. Each of these effluents is described below.

Boiler Acid Wash - Fossil Stations

In order to maintain boiler efficiency, acid washing of the waterside of boiler tubes is required to remove metal oxides which deposit on the heat exchange surfaces. These washes are conducted infrequently; generally every 2 - 6 years depending on the number of operating hours. During the MISA monitoring period, Lakeview, Lambton and Nanticoke conducted boiler acid washes. Wastewater from boiler acid washes at Lakeview, monitored upstream of treatment at ctrlpt 1900, are directed for co-treatment and monitoring with coal pile runoff in the coal pile drainage ponds (ctrlpt 1800). At Lambton boiler acid washes are directed to an acid wash pond. If necessary, the contents of the pond are neutralized using caustic. Overflow from the pond (monitored at ctrlpt 1500) is directed to Lake Lambton (ctrlpt 1100). At Nanticoke, boiler acid wash is directed to the ash lagoons for co-treatment with boiler bottom/fly ash (ctrlpt 0100). Boiler acid washes at Nanticoke were monitored untreated, upstream of the ash lagoons. Lennox did not discharge boiler acid washes during the MISA monitoring period. When conducted acid washes are held in a pond for evaporation. Up to the MISA monitoring period, boiler washes had not been conducted at Atikokan or Thunder Bay. At Thunder Bay, a vinyl lined containment pond is available to accept any boiler cleaning

wastes for treatment with lime. The neutralized effluent will be routed to the ash treatment system before discharge. A containment pond does not exist at Atikokan; therefore, boiler cleaning wastes will likely be discharged to a clay lined containment ditch. After neutralization overflow from the ditch will be unblocked to drain to the former mine waste pond which is also used at this site to collect coal pile runoff.

MISA Monitoring Data on Boiler Acid Washes - Fossil Stations

Analytical: A summary of average concentrations for all parameters found in wastewaters from boiler acid washes is provided in table 41 of appendix B. Lakeview, Lambton and Nanticoke conducted boiler acid washes during the MISA monitoring period. One discharge was reported from Lakeview and two discharges from Lambton. Parameters found at highest concentrations were boron, lithium, strontium and iron. Four discharges were sampled (upstream of treatment) for boiler acid washes conducted at Nanticoke. Levels of all contaminants are higher than those found in boiler acid washes at Lakeview or Lambton. Sixteen parameters were found. Parameters found at the highest concentrations were ammonia+ammonium, total kjeldahl nitrogen, dissolved organic carbon, total phosphorus, total suspended solids, aluminum, cadmium, copper, lead, molybdenum, nickel, zinc, iron and phenolics (4AAP).

Toxicity: Toxicity testing was not required for boiler acid wash effluent because monitoring was conducted upstream of treatment.

Air Preheater Wash - Fossil Stations

Before entering the furnace, combustion air is pre-heated using recovered heat. In order to maintain heat exchange efficiency, air pre-heater tubes are washed with water to remove fly ash which accumulates on the heat exchange surfaces. Air pre-heater wash water will be high in suspended solids and dissolved metals. These washes are required infrequently (approximately twice a year) depending on the number of operating hours, station design and type of coal. Up to the time of MISA monitoring, air pre-heater washes had not been conducted at Atikokan or Thunder Bay. Pre-heater washes at these stations will be very infrequent because the electrostatic precipitators are situated on the hot side of the pre-heaters. When performed, air pre-heater washes at Thunder Bay will be channelled to a containment pond for treatment and analysis prior to discharge. Atikokan plans to treat air pre-heater washes in the clarifiers of the ash treatment system. Lakeview directs air pre-heater

washes to the bottom ash settling pond. After pre-heater washes are performed, the pond is treated with lime to a pH of 8 - 9.5. Effluent from the pond is then passed through the ash filtration plant. At Lennox, air pre-heater washes are directed through a primary surge lagoon and a secondary settling lagoon. A monitoring and control system adjusts the pH of the wastewater by injecting sodium hydroxide prior to entering the lagoons. At Nanticoke, air pre-heater washes are discharged to the ash lagoons. At Lambton, before performing an air pre-heater wash, one ash settling tank is completely drained to accept the pre-heater wash waste. Sodium hydroxide is injected into the tank via the neutralization sump to adjust the pH. The tank is then put back into regular service and the contents passed through the ash filtration plant prior to discharge.

MISA Monitoring Data on Air Pre-heater Washes - Fossil Stations

Analytical: A summary of average concentrations for all parameters found in wastewaters from air pre-heater washes is provided in table 41 of appendix B.
Air pre-heater washes were conducted at Lakeview, Lambton and Nanticoke during the MISA monitoring period. Wash waters at Lakeview and Lambton were high in boron and lithium. The pre-heater wash at Lakeview was also high in iron. At Nanticoke, pre-heater washes were conducted on all eight boilers during the MISA monitoring period. Wash effluent was high in total phosphorus, total suspended solids, aluminum, boron, cadmium, chromium, cobalt, copper, lead, lithium, molybdenum, nickel, strontium, thallium, vanadium, zinc and iron.

Toxicity: Toxicity testing was not required for boiler acid wash effluent because monitoring was conducted upstream of treatment.

Boiler External Washes - Fossil Stations

External surfaces of boilers are washed to remove accumulated ash. These external washes are conducted very infrequently. During the MISA monitoring period Nanticoke boiler units 2, 4 and 7 were washed. Wastewaters generated were monitored prior to receiving treatment in the ash lagoons.

MISA Monitoring Data on External Boiler Washes

Analytical: A summary of average concentrations for all parameters found in wastewaters from boiler external washes is provided in table 41 of appendix B. One sample was reported for

each unit at Nanticoke. Parameters found at the highest concentrations were ammonia+ammonium, nitrate+nitrite, total kjeldahl nitrogen, dissolved organic carbon, total organic carbon, total suspended solids, aluminum, boron, cobalt, cadmium, chromium, copper, lead, lithium, molybdenum, nickel, strontium, zinc, iron, phenolics (4AAP) and oil & grease.

Toxicity: Toxicity testing was not required for boiler acid wash effluent because monitoring was conducted upstream of treatment.

Boiler Lay-up - Nuclear Stations

Boiler lay-up is treated water used to fill and protect boilers and associated pipework from corrosion during extended outages. Treatment chemicals like those used to maintain boiler feedwater chemistry (ie. hydrazine, ammonia) are used but at higher concentrations. At nuclear stations, boilers in a wet lay-up state provide the heat sink for a fuelled, shutdown reactor which is required under the operating license issued by the Atomic Energy Control Board (AECB). At all generating stations (fossil and nuclear) boiler lay-up is discharged untreated. Boiler lay-up was discharged only at Bruce-B NGS and Pickering NGS during the MISA monitoring period.

MISA Monitoring Data on Nuclear Station Boiler Lay-up

Analytical: A summary of average concentrations for all parameters found in boiler layup effluent is provided in table 41 of appendix B. Eleven parameters were found in boiler lay-up effluent. Parameters found at the highest concentrations included ammonia and copper at Bruce-B and copper, nickel, zinc, iron and oil & grease at Pickering.

Toxicity: A single sample collected from Pickering boiler lay-up effluent was toxic to both Daphnia magna and rainbow trout.

Darlington NGS Heating Steam Condensate - Control Point 2700

During winter stations are heated using boiler steam. Condensate from heating steam is normally reused. At Darlington NGS temporary construction boilers were used to provide heat and condensate from this system was discharged. This effluent was monitored at control point 2700 under the MISA monitoring regulation.

MISA Monitoring Data on Darlington Heating Steam Condensate

Analytical: A summary of average concentrations for all parameters found in heating steam condensate is provided in table 41 of appendix B. Ten parameters were found in heating steam condensate from Darlington NGS. The quality of this effluent was similar to boiler blowdown. Parameters found at the highest concentrations were iron and zinc.

Toxicity: Heating steam condensate was not tested for toxicity.

3.5.5 Building Effluent

Building Effluent - Fossil Stations

Building effluent streams were monitored at four fossil generating stations for a total of twenty-eight streams. Building effluent streams were not monitored at Atikokan or Thunder Bay generating stations because they are composed of typically noncontaminated service cooling water. At both Atikokan and Thunder Bay bottom ash hopper overflows are directed to the ash transport water treatment system. Floor drains with potential for solids contamination are also directed to the ash treatment system. Potentially oily floor drains are directed to the oil water separator. At Atikokan cooling water for all oil heat exchangers is also directed through the stations oil/water separator.

Effluent streams monitored at fossil stations under the classification of building effluent are of two types; 1.) boilerhouse/turbine hall drainage and 2.) pumphouse drainage.

1.) Boilerhouse/Turbine Hall Drainage: These effluent streams are composed of approximately 95% cooling water. The cooling water is used in heat exchangers for cooling transformers and lubrication oil. There is potential for leaks or spills of oil to the cooling water. The remaining effluent (approx. 5%), originates primarily from the bottom ash hopper overflow drains (ash hopper seal and ash hopper quench overflow). At Lakeview, Lambton and Nanticoke, overflow from the bottom ash hopper system is expected to contribute the bulk of the net suspended solids loading to building effluent streams. Some monitoring for TSS in hopper overflows at Lakeview was conducted after the MISA monitoring period[3]. Concentrations were typically 40 mg/L. Overflow from the bottom ash hopper at Atikokan and Thunder Bay is directed to the ash treatment system. Floor drains contribute a minor proportion to the volume to these streams. There is

potential for spills of oil, ash or coal to contaminate floor drains. Flows of boilerhouse/turbine hall drainage range from 15,000 to 50,000 m^3/day depending on the station.

2.) Pumphouse Drainage: This effluent is composed of leakage from cooling water pump glands/seals. There is potential for leaks and/or spills of oil from the pumps. Suspended solids may be picked up from floors and/or concrete gutters. Flow from these effluents are low (<500 m^3/day) in comparison to boilerhouse/turbine hall drainage.

One additional building effluent monitored at Lambton which does not fit the two general classes of building effluent described above originates from the coal yard maintenance building. This effluent is composed primarily of water used to wash down coal scrapers or for other maintenance activities. This effluent drains through an oil/water separator prior to the MISA monitoring point (control point 2200).

The number of building effluent streams monitored at each fossil station and the range of estimated flows are provided in table 3.8. The flows are revised estimates based on additional information obtained after the MISA monitoring period[4]. Flows are m^3/day/stream except where indicated.

Table 3.8
Range of Effluent Volumes
Building Effluent - Fossil Stations

Station	Boilerhouse turbine hall		Pumphouse		Other	
	Number of Streams	~Average Flows m^3/day/stream	Number of Streams	~Average Flows m^3/day/stream	Number of Streams	~Flow
Lakeview	5	34,000 - 74,000	1	125	-	-
Lambton	2	30,000	3	11 - 300	1	0.006 m^3/10 min
Lennox	4	14,800	1	450	-	-
Nanticoke	8	25,700 - 48,800	4	0.35 m^3/3 min.	-	-

Building Effluent - Nuclear Stations

Building effluent streams were monitored on a monthly basis at 36 control points at nuclear stations. At Bruce-A, Bruce-B and Darlington nuclear stations, streams monitored under the classification of building effluent are composed of leakage from the boiler/feedwater system. Wastewaters from inactive floor and equipment drains are directed to sumps, when a sump is full it is batch discharged to the cooling water outfall. There is potential for oil to enter sumps through leaks and floor and

equipment washings. At Pickering service cooling water is combined with boiler/feedwater system drainage prior to monitoring; therefore, the volumes are much greater.

The number of building effluent streams monitored at each station and the range of estimated flows are provided in table 3.9. Flows are m^3/day/stream. The flows are revised estimates based on additional information obtained after the MISA monitoring period[4].

Table 3.9
Range of Effluent Volumes
Building Effluent - Nuclear Stations

Station	Building Effluent	
	Number of Streams	~Average Flows m^3/day/stream
Bruce-A NGS	4	17 - 19
Bruce-B NGS	8	<1 - 175
Darlington NGS	16	<1 - 15
Pickering NGS	8	1 - 2700

MISA Monitoring Data on Building Effluent:

Analytical: A summary of average concentrations for all parameters found in building effluent at fossil stations is provided in table 34 of appendix B. Data for building effluent at nuclear stations are provided in table 36.

Building effluent streams were monitored at a monthly frequency. Twelve parameters were found in building effluent at fossil stations, eighteen parameters at nuclear stations.

Lakeview and Nanticoke building effluent data show increased levels of TSS compared to intake water data. TSS levels at Lambton and Lennox are comparable to intake water levels.

Darlington NGS building effluent showed higher concentrations of TSS, iron, zinc, copper, phenolics (4AAP) and oil & grease in building effluent compared to other nuclear stations. Building effluent at Pickering was high in TSS (avg. = 63 mg/L) and iron (avg. = 529 ug/L).

At Darlington the discharge volumes are quite low; therefore, the loadings are also low. Loadings from building effluent streams at Darlington (and Bruce-A and Bruce-B) comprise a minor proportion of the total station loadings. At Pickering

NGS, loadings are much larger because building effluent streams are mixed with large volumes of cooling water.

Toxicity: Toxicity testing was not conducted on building effluent.

3.5.6 Cooling Water

At both fossil fuelled and nuclear powered stations, there are two main cooling water systems, condenser cooling water (CCW) and service cooling water (SW).

Condenser cooling water (CCW) is used to condense low pressure steam after it has served its purpose as the driving force for the power turbines. CCW is returned to the lake up to 11.1 degrees celsius warmer than intake water. Daily on-line temperature monitoring of CCW at both intake and outfall is carried out at all fossil and nuclear stations.

Service water is primarily used for cooling equipment such as lube oil heat exchangers, air conditioning units, etc. and, at most stations, is discharged along with the CCW. Some service water is used in the ash handling process at fossil stations. Service water is also used as feed water to the WTP for production of high quality boiler feed water. Service water is chlorinated during summer months for control of zebra mussels.

MISA Monitoring Data on Cooling Water Effluent:

Analytical: Cooling water streams were monitored at a monthly frequency. A summary of average concentrations for all parameters found in cooling water effluent is provided in tables 37 and 38 of appendix B. Temperature data for fossil stations and nuclear stations are provided in table 50 and 51 respectively.

Toxicity: With the exception of the reactor building service water at Pickering NGS-B, all cooling water samples collected were non-toxic to both Daphnia magna and rainbow trout. Reactor building service water at Pickering NGS-B was toxic to both Daphnia Magna and rainbow trout in two of the four samples tested. This effluent was not expected to be found toxic. Analytical data showed high levels of copper in both toxic samples. This stream is currently being resampled re: Minutes of LSS meeting - Action: Ontario Hydro.

3.5.7 Storm Waters

Representative storm water streams were monitored at all sites in the EPGS during one storm event each month. With the exception of runoff from coal piles and those stations which direct potentially oily stormwaters to an oil/water separator (ie. Lennox, Pickering, Darlington) there is no treatment provided for stormwater at any of the generating stations. Storm waters discharge directly to the receiving watercourses or to CCW through culverts or drains. The purpose of monitoring storm water was to provide a comparison between the quality of storm waters and process effluent streams.

MISA Monitoring Data on Storm Water Effluent:

Analytical: A summary of average concentration data for all parameters found in storm waters is provided in tables 42 and 44 of appendix B. Parameters found at the highest concentrations in storm waters, depending on the site, were total suspended solids, iron, aluminum, zinc, arsenic, phenolics (4AAP) and oil & grease. PCBs were found in storm waters at Lakeview, Lambton, Lennox, Decew Falls and Bruce-A. Octa and hepta dioxin/furans were found in storm waters at R.L. Hearn.

Toxicity: Toxicity testing was not conducted on stormwaters.

3.6 Effluent from Hydraulic Generating Stations

Wastewaters generated by hydraulic stations are minimal in comparison to fossil and nuclear powered generating stations. Building sump discharges were monitored at each of the six selected hydraulic stations. Building sumps collect floor and roof drainage, inspection tunnel drainage and equipment drainage. Water from periodic dewatering of turbines prior to maintenance is also discharged to building sumps. In addition, transformer cooling water was monitored at two stations; Sir Adam Beck and Decew Falls.

MISA Monitoring Data on Effluent from Hydraulic Stations:

Analytical: Concentration data for building effluent are provided in table 35 of appendix B. Parameters found at highest concentrations in building effluent were total suspended solids and iron. Data for cooling water are provided in table 39. Concentrations for parameters found in cooling water are similar

to intake levels. Data for storm waters are provided in table 43. Parameters found at the highest concentrations in storm waters, depending on the site, were total suspended solids, iron, aluminum, zinc, arsenic, phenolics (4AAP) and oil & grease.

Toxicity:
Toxicity testing was conducted on transformer cooling waters at two stations; Decew Falls and Sir Adam Beck. None of the samples were toxic.

Nuclear Support Facilities

Nuclear support facilities include the Bruce Heavy Water Plant (BHWP), Bruce Nuclear Power Development Services (BNPDS) and the Darlington Construction Site. Since each of these facilities are unique they are discussed separately.

3.7 Bruce Heavy Water Plant (BHWP)

The following sections provide a description of each effluent type at the BHWP including; wastewater volumes, sources, technology in place and a summary of the analytical and toxicity results from the MISA monitoring period.

3.7.1 Effluent Volumes - Bruce Heavy Water Plant:

A total of eight effluent streams were monitored at the Bruce Heavy Water Plant including two storm water streams. Table 3.10 lists each of the streams (excluding storm water) monitored and the average discharge volumes for each effluent over the MISA monitoring period.

Table 3.10
Bruce Heavy Water Plant (BHWP)
Average Effluent Volumes

Effluent Description / Units of Flow	Control Point	Average Flow
Clarifier Building Effluent, m^3/day	0100	5,050
Cooling Water Outfall, m^3/day	0200	1,510,000
Carbonated Equipment/Drain **, m^3/discharge	0300	16 (6)
Effluent Lagoons, m^3/discharge	0400	705 (12)
Process Effluent, m^3/day	0500	75,200
Surface Water Treatment Facility, m^3/discharge	0600	1,880 (12)

Notes: # of discharge volumes reported are indicated in brackets for intermittent streams.
** = monitored upstream of surface water treatment facility

3.7.2 BHWP Process Effluent - Control Point 0500

Effluent from the enriching units, depleted in D_2O and saturated with H_2S, is passed through an H_2S recovery system. H_2S is flashed and then steam stripped to remove remaining dissolved H_2S. Recovered H_2S is reabsorbed into the incoming process feed water. The H_2S recovery system is designed to lower the H_2S concentration to <0.1 mg/L. Monitors are in place on the discharge from the effluent stripper which automatically divert process effluent to the effluent lagoons (control point 0400) if the H_2S concentration exceeds 1.0 mg/L. Most of the H_2S losses to the environment are through the process effluent. Ontario Hydro estimates that less than 10% of H_2S losses are through other process drains and heat exchanger leaks[5].

Seal oil is used in the H_2S blower seals to prevent escape of H_2S to the atmosphere. Some oil leakage into process water does occur. Estimates of daily oil loadings based on oil consumption data are provided in Table 3.11 [6,7,8,9].

Table 3.11
Oil Emission Rate **

Year	Hydrocarbon Seal Oil Losses (kg/day) **
1990	81[6]
1991	52[7]
1992	132[8]
1993	145[9]

** Oil losses are based on oil consumption data.

MISA Monitoring Data - Control Point 0500

Analytical: A summary of the monitoring results are provided in tables 26 and 27 of appendix B. Nine parameters were found in BHWP process effluent. The source of sulphide is H_2S which is the basic process chemical used in heavy water production. Oil and grease is due to leakage from blower seals.

Toxicity: Twelve samples from PR 0500 were tested for toxicity to both Daphnia magna and rainbow trout during the MISA period. None were toxic.

3.7.3 BHWP Effluent Lagoons - Control Point 0400

In the event of a process upset or H_2S leak which causes the concentration in the process effluent to increase to $\geq$1 mg/L. Process effluent is diverted to the effluent lagoons . The effluent lagoons are designed to provide a hold-up time of 6 -7

hours for one plant. This time is considered adequate to allow corrective action in the event of a process upset. The lagoons are aerated to promote removal/oxidation of H_2S and discharged when H_2S levels are acceptable. The lagoons have an on-line H_2S analyzer to monitor any drainage from the lagoons.

Treated wastewater from the "process drain system" is also directed to the effluent lagoons. The process drain system receives and treats H_2S contaminated leaks and drainage from various areas of the plant. Process drain wastewater is steam stripped prior to discharge to the effluent lagoons. The flow of this stream is intermittent.

MISA Monitoring Data - Control Point 0400

Analytical: A summary of the monitoring results from the process effluent lagoons (PR 0400) is provided in table 26 and 27 of appendix B. Eleven parameters were found in effluent from the effluent lagoons. Sulphide which was expected to be found in this stream was not identified as a "priority 1" parameter. The primary source of iron is expected to be corrosion. The presence of oil & grease is due to leakage of seal oil from blowers.

Toxicity: Discharges from the effluent lagoons were not tested for toxicity.

3.7.4 Building Effluent - Control Point 0100

Effluent monitored at control point BE 0100 is comprised of wastewaters combined from a number of sources. Each source is described briefly under the following sections.

Degasser Hotwell Drainage: The main flow is degasser hotwell drainage which is comprised of a mixture of condensed process steam and cooling water (~4,580 m^3/day).

Process Filter Backwash Sump: Process feedwater is filtered in sand filters and degassed before entering the process. Backwash from the filtration process is directed to the filter backwash sump before discharge to BE 0100. This stream is high in suspended solids. Filtered water is acidified to facilitate degassing. Degassed water is neutralized to pH 6.5 by addition of sodium hydroxide prior to entering the process.

Domestic Water Drains: Effluent from the plant domestic water treatment system are;

- filter backwash and rinse from domestic water filters
- overflow and drainage from domestic water contact tank

- elevator pit floor drains
- elevator pit mechanical room clean-out

This stream is high in TSS and may contain oil from the elevator pit.

Other intermittent streams which combine with degasser hotwell drainage include:

- clarifier overflow
- cooling water and supply pit drains
- cooling water return header and stand pipe drains
- condensate blowdown drum discharge: may contain ammonia from boiler treatment chemicals and copper from steam tracing

The total flow from intermittent streams entering BE 0100 is approximately ~778 m^3/day.

MISA Monitoring Data - Control Point 0100

Analytical: A summary of the monitoring results is contained in table 36 of appendix B. Four parameters were found in samples collected from control point BE 0100. TSS and iron were found at the highest concentrations. The primary source of TSS is expected to be from the backwash of sand filters.

Toxicity: Toxicity samples were not collected at control point BE 0100.

3.7.5 Surface Water Treatment Facility - Control Point 0600

The surface water treatment facility was constructed to control the high levels of iron found in storm waters at the BHWP and the high levels of iron and pH found in wastewaters produced from pipe treating and tower steam-outs associated with unit outages at BHWP.

The surface water treatment facility consists of a earthen embankment lagoon divided into three cells; an inlet cell, a dirty cell and a clean cell. Wastewater in the dirty cell is circulated over a bed of limestone to raise pH and reduce concentrations of soluble ferrous (Fe^{+2}) iron prior to transfer of contents to the clean cell. Surface oil collected by an oil boom in the dirty cell is removed periodically with mobile equipment.

Carbonated equipment/equipment drains, Control Point 0300: Carbonated equipment drains were monitored upstream of the SWTF in order to quantify contaminant levels prior to dilution with other streams entering the SWTF. Effluent passing through this

control point includes wastewater generated from cleaning of heat exchangers and spent carbonate solution (1-2% Na_2CO_3) which is used in the enriching units in preparation for unit outages.

MISA Monitoring Data - Control Points 0600 and 0300

Analytical: A summary of average concentrations for parameters found in effluent from the surface water treatment facility are provided in table 41 of appendix B.
Eight parameters were found. Parameters found at the highest concentrations were iron and aluminum.

A summary of average concentrations for parameters found in effluent from equipment carbonating/cleaning (0300) which was monitored upstream of the surface water treatment facility are provided in table 41 of appendix B. Seven parameters were found. Parameters found at the highest concentrations were copper, zinc, sulphide and iron. There are no sources of H_2S discharging through this control point. Sulphide found in this stream is expected to be from the cleaning wastes generated when removing metal sulphide scaling from heat exchanger tubes.

Toxicity: The surface water treatment facility (0600) and equipment cleaning (0300) were not monitored for toxicity.

3.7.6 Cooling Water Outfall - Control Point 0200

Chemicals are not added to cooling water; however, a leak in an exchanger could result in H_2S in the cooling water. H_2S monitors are in place to detect any leaks.

MISA Monitoring Data - Control Point 0200

Analytical: A summary of average concentrations for all parameters found in cooling water effluent from BHWP is provided in table 38 of appendix B. Five parameters were found in cooling water. Levels were similar to intake concentrations. Data from temperature monitoring is contained in table 52 of appendix B.

Toxicity: Four samples of cooling water were tested for toxicity. All were non-toxic.

3.7.7 Storm Water

Two storm water streams were monitored at the Bruce Heavy Water Plant.

MISA Monitoring Data on BHWP Storm Waters

Analytical: Average concentrations for parameters found in storm water are contained in table 45 of appendix B. Parameters found at the highest concentrations were total suspended solids and iron.

Toxicity: Storm waters were not tested for toxicity.

3.8 Bruce Nuclear Power Development Services (BNPDS)

A total of fourteen effluent streams were monitored at BNPDS including six storm water streams. The following sections provide a description of each effluent type including; wastewater volumes, sources, technology in place and a summary of the analytical and toxicity results from the MISA monitoring period.

3.8.1 Effluent Volumes - BNPDS:

Table 3.12 lists the average wastewater volumes (excluding storm water) discharged from each effluent type at BNPD over the MISA monitoring period.

Table 3.12
Bruce Nuclear Power Development Services
Average Effluent Volumes

Effluent Description / Units of Flow	Control Point	Average Flow
Sewage Treatment Plant, m^3/day	0100	1680
Steam Transformer Plant - A Lake, m^3/day	0200	550
Steam Transformer Plant - A NGS A, m^3/day	0300	5230
Steam Transformer Plant - O, m^3/day	0400	9085
Chemical Waste Pond, m^3/discharge	0600	590 (2)
Waste Disposal Site, m^3/discharge	1300	1271 (10)
Neutralization Sump **, m^3/day	1400	235
Cooling Water Outfall, m^3/day	1500	11600

Notes: Number of discharge volumes reported are indicated in brackets for all intermittent streams. All other effluent streams are discharged daily.
** = monitored upstream of STP - O (ctrlpt 0400)

3.8.2 Bruce Bulk Steam System (BBSS)

The purpose of the BBSS is to supply BHWP with medium pressure (MP) steam for the production of heavy water. MP steam is also provided for freeze protection, building heating and for use at the Bruce Energy Centre. Medium pressure steam is produced in one of two steam transformer plants, STP-A or STP-O. Effluent streams from both STP-A and STP-O were monitored under the MISA monitoring regulation.

3.8.3 Steam Transformer Plant-A (STP-A) - Control Points 0200 and 0300

High pressure (HP) steam from Bruce-A is converted to medium pressure steam in steam transformer plant - A (STP-A). STP-A is the normal source of MP steam. Effluent from STP-A is composed primarily of drainage from the blowdown tanks and flash tanks. Flowrate from these tanks depends on the number of units operating and the load on each unit. Lesser discharge volumes are contributed by:

- HP condensate return pump cooling water,
- Air compressor cooling water,
- HP condensate pump pit drainage: collects water from gland seal leaks or water from a unit when it is drained. Due to potential oil contamination from gland leaks this effluent passes through an oil separator. Under normal operation flow is minimal,
- Relief valve drainage: no flow under normal operation,
- Roof drains and area drainage: present only during rain or thaw.

Due to the large number of effluent streams from STP-A, wastewaters were monitored as combined effluents at two discharge points. Control point 0200 includes flash tank drainage and roof/area drains and discharges directly to Lake Huron. Control point 0300 includes the remainder of STP-A drainage and discharges into the intake channel at Bruce NGS-A.

MISA Monitoring Data - Control Points 0200 and 0300

Analytical: Average concentration and loading data for all parameters found in the above streams are provided in tables 26 and 27 of appendix B. Eleven parameters were found in samples collected at control point 0200, ten parameters were found in samples collected at control point 0300. Levels of all parameters were comparable to intake levels.

Toxicity: Monthly toxicity testing was conducted at both control point 0200 and control point 0300. Two samples collected from control point 0200 were toxic to Daphnia magna. All other

samples were non-toxic to both Daphnia magna and rainbow trout. A summary of toxicity test results is provided in table 3 of appendix C.

3.8.4 Steam Transformer Plant-O (STP-O)/Condensate Plant - Control Point 0400

Wastwaters monitored at control point 0400 includes drainage from STP-O and the BNPD Services Condensate Plant.

The purpose of STP-O is to provide backup MP steam in the event that Bruce NGS-A cannot provide enough steam to STP-A. High pressure steam is supplied to STP-O by the Bruce steam plant.

Bruce Steam Plant: The Bruce steam plant houses two oil fired boilers which are kept on standby to provide high pressure steam to STP-O when MP steam demand cannot be met by STP-A. Effluent from the Bruce steam plant includes boiler blowdown and floor drains. The main effluent is boiler blowdown (~262 m^3/day). Under normal operation there is minimal effluent from the floor drains. Floor drainage from the Bruce steam plant passes through an oil/water separator before tying in with boiler blowdown effluent. Effluent streams from the Bruce steam plant were monitored at control point 0400 after combining with other STP-O drainage.

Utilities Building: The utilities building houses the demineralized water storage tanks, the STP-O blowdown tank and an emergency boiler. Effluent streams from the utilities building include condensate makeup pump cooling water ~65 m^3/day and STP-O blowdown tank drainage ~982 m^3/day. These streams were monitored at control point 0400 after combining with other STP-O drainage.

The remaining drainage from STP-O includes:

- HP condensate return pump cooling water ~65 m^3/day/unit,
- flash tank drainage ~982 m^3/day,
- intermittent blowdown ~0 - 2290 m^3/day,
- yard drainage: weather dependent.

Condensate Plant: The purpose of the condensate plant is to provide demineralized makeup water for the Bruce Bulk Steam System. The condensate plant is a water treatment plant consisting of sand filtration, carbon filtration and ion exchange treatment. Regeneration effluent is directed to the neutralization sump. Under normal operation the neutralization sump is pumped out twice per day. Sand filter backwash is relatively constant ~209 m^3/day. Carbon filters are backwashed about once per month (approx. 227 m^3). Neutralization sump and backwash effluent streams were monitored at control point 0400 after combining with other STP-O drainage. Neutralization sump

effluent was also monitored at the discharge from the neutralization sump (control point 1400) upstream of control point 0400.

MISA Monitoring Data - Control Point 0400

Analytical: A summary of average concentration and loading data for all parameters found in wastewater monitored at control point 0400 are provided in tables 27 and 28 of appendix B. Ten parameters were found. Levels of all parameters were comparable to intake levels.

Toxicity: Monthly toxicity testing was conducted at control point 0400. All samples were non-toxic to both Daphnia magna and rainbow trout.

MISA Monitoring Data - Control Point 1400

Analytical: A summary of average concentration and loading data for all parameters found in neutralization sump effluent (ctrlpt 1400) which was monitored upstream of control point 0400 are provided in tables 18 and 19 of appendix B. The neutralization sump at BNPD receives only regeneration wastes; therefore, the parameters found represent those concentrated on ion exchange resins, corrosion products and impurities contained in regenerant chemicals. Raw water to this WTP is not chlorinated and trihalomethane compounds were not found in this effluent.

Toxicity: Toxicity testing was not conducted at control point 1400.

3.8.5 Sewage Treatment Plant - Control Point 0100

An activated sludge treatment plant receives all domestic sewage produced at the BNPD site. Alum is added to the aeration tank for phosphorus removal. Final effluent is disinfected using chlorine gas (Cl_2). Following a two stage digestion, sludge is transferred to a sludge lagoon. Sludge from the lagoon is spread on local farm land once per year (approx. 1360 m^3/year).

MISA Monitoring Data - Control Point 0100

Analytical: A summary of average concentration and loading data for all parameters found effluent from the sewage treatment plant is provided in tables 27 and 28 of appendix B. Seventeen parameters were found in samples collected at control point 0100. Parameters found at highest concentrations were ammonia,

aluminum, strontium, chloroform and total residual oxidants. The source of aluminum is alum added for phosphorus removal. Chloroform and bromodichlormethane are formed during chlorination of the final discharge.

Toxicity: Monthly toxicity testing was conducted at control point 0100. All samples were non-toxic to both Daphnia magna and rainbow trout. A summary of toxicity test results is provided in table 3 of appendix C.

3.8.6 Radioactive Waste Storage Site - Control Point 1300

The purpose of the radioactive waste storage site is to provide safe, retrievable storage for the solid radioactive waste produced by Ontario Hydro. Wastes with high radiation fields are placed in an appropriate storage structure. Incinerable wastes are burned in the radioactive incinerator and the ashes stored in a low level storage building. There are two stormwater drainage pathways from the radioactive waste storage site. Drainage from areas around low level storage buildings is directed to the site drainage. Drainage from other storage structures passes through a sand filter bed before entering one of the site drainage ditches.

MISA Monitoring Data - Control Point 1300

Analytical: A summary of average concentrations for all parameters found in effluent from the BNPD waste disposal site is provided in table 40 of appendix B. Eight parameters were found in samples collected at control point 1300. Parameters found at highest concentrations were total suspended solids, iron and zinc.

Toxicity: Toxicity testing was not conducted at control point 1300.

3.8.7 Chemical Waste Pond - Control Point 0600

The chemical waste pond is used to retain wastewater generated from steam plant air preheater washing and boiler acid cleaning. Boiler cleaning is conducted infrequently. Each preheater is washed once per year and resulting slurry is neutralized by adding caustic soda to the pond. Once and approval from the MOEE district office is obtained, supernatant from the pond is pumped to the Lake Huron via control point 0400. Volumes discharged over the years 1990 to 1993 are provided in table 3.13.

Table 3.13
BNPD Chemical Waste Pond -
Discharge Volumes

Year	Volume Discharged, m^3
1990	580
1991	600
1992	360
1993	450

MISA Monitoring Data - Control Point 0600

Analytical: A summary of average concentrations for all parameters found at control point 0600 is provided in table 41 of appendix B. There were only two discharges from the chemical waste pond during the MISA monitoring period. Parameters detected in both samples were dissolved organic carbon, copper and iron.

Toxicity: Toxicity testing was not conducted at control point 1300.

3.8.8 Cooling Water - Control Point 1500

Analytical: Average concentrations for all parameters found at control point 1500 are provided in table 38 of appendix B. Six parameters were found in cooling water effluent at BNPDS. Concentrations were similar to intake levels.

Toxicity: Four samples of cooling water were tested for toxicity. All were non-toxic (table 3 - appendix C).

3.8.9 Storm Water

Six storm water streams were monitored at BNPDS.

MISA Monitoring Data on BNPDS Storm Waters

Analytical: Average concentrations for all parameters found in storm waters are provided in table 45 of appendix B. Parameters found at the highest concentrations were aluminum, iron, total suspended solids and phosphorus.

Toxicity: Storm waters were not tested for toxicity.

3.9 Darlington Construction Site

The Darlington Nuclear Generating Station was still under construction during the MISA monitoring period. The Darlington construction site was subject to the MISA Effluent Monitoring Regulation because wastewaters are produced on the construction site which discharge directly to Lake Ontario and although some of the effluent streams associated with the construction site are temporary, others will be ongoing wastewaters associated with the completed Darlington NGS.

A total of twelve effluent streams were monitored at the Darlington Construction Site including two storm water streams. The following sections provide a description of each effluent type including; wastewater volumes, sources, technology in place and a summary of the analytical and toxicity results from the MISA monitoring period.

3.9.1 Effluent Volumes - Darlington Construction Site:

Table 3.14 lists the average wastewater volumes (excluding storm water) discharged from each effluent type at the Darlington construction site over the MISA monitoring period.

Table 3.14
Darlington Construction Site
Average Effluent Volumes

Effluent Description / Units of Flow	Control Point	Average Flow
Tritium removal facility boiler blowdown, m^3/discharge	0100	2.4 (114)
Construction boiler blowdown, m^3/discharge	0200	151 (365)
Air compressor cooling water, m^3/day	0300	215
Waste lagoon, m^3/discharge	0400	875 (2)
Waste lagoon, m^3/discharge	0500	875 (2)
Tank 2 **, m^3/discharge	0600	21 (12)
Tank 4 **, m^3/discharge	0700	21 (12)
Sewage Treatment Plant, m^3/day	0800	390
Neutralization Sump, m^3/discharge	1100	29
Waste Settlement Pond, m^3/discharge	1300	111 (3)

Notes: Number of discharge volumes reported are indicated in brackets for all intermittent streams. All other effluent streams are discharged daily.
** = monitored upstream of the STP (ctrlpt 0800).

3.9.2 Neutralization Sump - Control Point 1100

Two temporary water treatment plants were operated during the construction phase of Darlington NGS to provide high quality water for producing construction heating steam. One WTP provided feed water to electric boilers, one WTP provided feed water to oil fired boilers. These WTPs are now shutdown.

The plants used municipal water from Bowmanville as feed water. Treatment operations for the electric boilers included dealkalizer columns, a degassing tower, and sodium zeolite softeners. Sulphuric acid and brine were used to regenerate the zeolite resins. Treatment for the oil fired boilers included ion exchange softening only. Resins were regenerated with brine. The effluent was classed as neutralization sump effluent to be consistent with other WTPs; however, there was no sump.

MISA Monitoring Data - Control Point 1100

Analytical: Average concentration and loading data for all parameters found at in wastewater from the WTP at Darlington construction are provided in tables 18 and 19 of appendix B. Sixteen parameters were found. Parameters found at highest concentrations were chemical oxygen demand, aluminum, copper, iron, strontium, mercury, phenolics and trihalomethanes (bromodichloromethane and chloroform). Sources of metals are the same as neutralization sumps at the power generating stations (ie. reagent impurities, corrosion, concentrating of metals on ion exchange resins). Phenolics may be present in new ion exchange resins if not purchased in the regenerated form[23].

Toxicity: Wastewater samples collected from the WTP at Darlington construction were toxic to Daphnia magna in 8 out of 12 samples and rainbow trout in 4 out of 12 samples. A summary of toxicity test results is provided in table 3 of appendix C.

3.9.3 Boiler Blowdown

Construction Boilers

Several small oil fired (12) and electrically heated boilers (4) provided steam for space and water heating during construction of Darlington NGS. The number of boilers in service varied, with steam demand being higher in the colder months. These boilers are now shutdown. Treatment chemicals were added for control of corrosion and scaling. Each operating boiler was blown down continuously to remove suspended and dissolved solids in order to maintain boiler water quality and thereby minimize scaling and corrosion. Small quantities of water are also blown

down intermittently to remove any sludge formed. Make-up water for the electric boilers is taken from the domestic water supply (chlorinated) originating from Bowmanville. In addition to domestic water, make-up water for the electric boilers is comprised of blowdown recovered from the electric boilers, condensate returns and compressor cooling water. Boiler feedwater undergoes chemical treatment prior to entering the boilers.

Tritium Removal Facility (TRF) Boiler Blowdown

There are six boilers which provide steam for the tritium removal facility (TRF). Operation of the TRF will be ongoing as part of the Darlington NGS. Blowdown from the TRF boilers is continuous and manual blowdown is implemented if necessary. Feedwater is delivered from the Darlington NGS WTP. Hydrazine is the only treatment chemical added.

From June 1, 1990 until June 12, 1990 boiler blowdown from the electric boilers and from the TRF boilers was sampled as a combined stream at control point 0200. Starting June 13, the TRF boiler blowdown was sampled separately at control point 0100 while blowdown from the electric boilers and from the oil fired boilers continued to be sampled at control point 0200. As of October 5, 1990, the effluent from all blowdown tanks, including the TRF, was routed to one large tank and sampled as control point 0200.

MISA Monitoring Data - Control Points 0100

Analytical: Table 33 of appendix B contains average concentration data for all parameters found in blowdown effluent from the tritium removal facility (control point 0100). Six parameters were found. Parameters found at highest concentrations were copper and phenolics.

Toxicity: Samples of boiler blowdown from the tritium removal facility were toxic to Daphnia magna in 4 out of 9 samples and rainbow trout in 4 out of 9 samples. Table 3 of appendix C provides a summary of all toxicity test results.

MISA Monitoring Data - Control Point 0200

Analytical: Table 33 of appendix B contains average concentration data for all parameters found in effluent at control point 0200. Twenty-one parameters were found. Parameters found at highest concentrations were copper, iron, phenolics, bromodichloromethane and chloroform.

Toxicity: Samples of boiler blowdown collected at control point 0200 were toxic to Daphnia magna in 3 out of 6 samples and rainbow trout in 5 out of 6 samples. Table 3 of appendix C provides a summary of all toxicity test results.

3.9.4 Equipment Cleaning Effluent

Effluent streams monitored under the classification of equipment cleaning wastes at the Darlington Construction Site included commissioning wastes and the pipe cleaning facility.

Commissioning Waste Lagoons - Control Points 0400 and 0500

Water used to clean, test equipment during the commissioning process are pumped to a set of two aerated lagoons. Each lagoon has a capacity of approximately 4000 m^3. Wastewater directed to the lagoons include water used for hydrostatic testing, condenser leak testing, boiler and pipe cleaning and water from wet storage. Chemicals expected to be found in wastewater discharged to the lagoons include hydrazine and ammonia, used in hydrostatic testing and wet storage and dye, used for condenser leak testing. The lagoons are aerated to promote oxidation of hydrazine. The lagoons are discharged very infrequently. A long retention time allows photodegradation of dye.

MISA Monitoring Data - Control Points 0400 and 0500

Analytical: Table 41 of appendix B contains average concentration data for parameters found in these streams. Two discharges through each of control points 0400 and 0500 occurred during the MISA monitoring period. Parameters detected included aluminum, dissolved organic carbon, copper, zinc and iron. The pH was 9.0.

Toxicity: Wastewater from the lagoons was not tested for toxicity.

Pipe Cleaning Facility - Control Points 0600 and 0700

Before being used in construction of the Darlington generating station, pipe is cleaned and treated to prevent corrosion. The pipe cleaning facility has five tanks, each with a capacity of 17.7 m^3. Pipe is cleaned in two stages; firstly with a heated sodium hydroxide/detergent solution which removes any oily coatings, grease or dirt and then with heated phosphoric acid which removes rust. Piping is rinsed in rinse tanks between cleaning stages. Some carryover from the cleaning tanks to the rinse tanks is expected; therefore, effluent from each rinse tank

was monitored (control points 0600 and 0700). Water from the rinse tanks is discharged to the sewage treatment plant (control point 0800). Cleaned pipe is finally sealed with a heated mixture of phosphoric/chromic acids to prevent corrosion. Spent acid and base solutions are discharged to a holding tanks for eventual offsite disposal or pumped directly to tank trucks. Operation of the pipe pickling plant has ceased with the completion of Darlington NGS but will be used on an as-need basis to meet piping needs for all Ontario Hydro nuclear stations.

MISA Monitoring Data - Control Points 0600 and 0700

Analytical: Table 41 of appendix B contains average concentration data for parameters found in these streams. Nine parameters were found in samples collected at control point 0600. Ten parameters were found in samples collected at control point 0700. Parameters found at highest concentrations were phosphorus, copper, iron, phenolics, and chloroform.

Toxicity: Wastewaters from the pipe treating facility were not tested for toxicity because they are discharged to the sewage treatment plant.

3.9.5 Sewage Treatment Plant - Control Point 0800

The sewage treatment plant receives all domestic sewage from the construction site, generating station and tritium removal facility (ie. washrooms, showers). Wastewater from the pipe cleaning rinse tanks and a truck washing facility are also directed to the sewage treatment plant.

Influent to the sewage treatment plant is directed to a two compartment equalization sump which feeds two rotating biological contactors (RBCs). Effluent from the contactors enters a settling chamber. Settled sludge is recirculated to the equalizing sumps. During period of low flow, effluent from the settling chamber can be recycled to the equalizing sumps. Effluent passes through a chlorine (sodium hypochlorite) contact chamber prior to discharge to Lake Ontario. Sludge accumulated in the equalization chamber is pumped out approximately every two months and hauled for offsite disposal. Design flow of the sewage treatment plant is 1555 m^3/day.

MISA Monitoring Data - Control Point 0800

Analytical: Tables 26 and 27 of appendix B provide average concentration and loading data for parameters found in effluent from the Darlington sewage treatment plant. Twenty-five parameters were found. Parameters found at highest

concentrations were chemical oxygen demand, ammonia+ammonium, nitrate+nitrate, total Kjeldahl nitrogen, total phosphorus, total suspended solids, iron, zinc, chloroform, oil & grease and total residual oxidants.

Toxicity: Effluent from the sewage treatment plant was toxic to Daphnia magna in 3 out of 12 samples and to rainbow trout in 1 out of 12 samples. Table 3 of appendix C provides a summary of all toxicity test results.

3.9.6 Waste Settlement Pond - Control Point 1300

Excavated fill and debris from the construction of Darlington NGS, consisting primarily of wood and lesser quantities of concrete, metal, rubber and other waste, are buried under the waste disposal mound. A french drain under the mound and containment dykes around the mound direct any seepage and runoff to the waste settlement pond. Overflow from the pond, due to precipitation, discharges to Lake Ontario.

MISA Monitoring Data - Control Point 1300

Analytical: Table 40 of appendix B contains average concentration data for parameters found in samples collected at control point 1300. Seven parameters were found. Levels of all parameters were similar to intake levels.

Toxicity: Toxicity testing was not conducted at control point 1300.

3.9.7 Cooling Water - Control Point 0300

Cooling water is used at the Darlington construction site to cool air compressors (6) at the boiler house. No treatment chemical are added; however, sampling was conducted due to potential contamination from sealants and lubricants which are used in the compressors.

MISA Monitoring Data - Control Point 0300

Analytical: Six parameters were found in samples collected at control point 0300. Only iron was found at levels greater than intake. Table 38 of appendix B contains average concentration data for parameters found in this stream.

Toxicity: Four samples were collected from compressor cooling water and tested for toxicity to Daphnia magna and rainbow trout. None were toxic.

3.9.8 Storm Water

Two storm water streams were monitored at the Darlington Construction Site.

MISA Monitoring Data on Darlington Construction Site Storm Water

Analytical: Table 45 of appendix B contains average concentration data for parameters found in storm waters at the Darlington construction site. Parameters found at the highest concentrations were total suspended solids, aluminum, iron, zinc, and oil & grease.

Toxicity: Storm waters were not tested for toxicity.

3.10 Block Diagrams

Block diagrams for each fossil station, nuclear station and nuclear support facility are included in the following pages. Representative block diagrams are also provided for three of the six hydraulic stations monitored under the MISA program. The diagrams depict the configuration the effluent pathways existing during the MISA monitoring period and approximate flows. These diagrams were extracted from BAT reports for the EPG sector. Flow data contained in the tables of appendix B have been revised and may differ from flow data entered on the block diagrams.

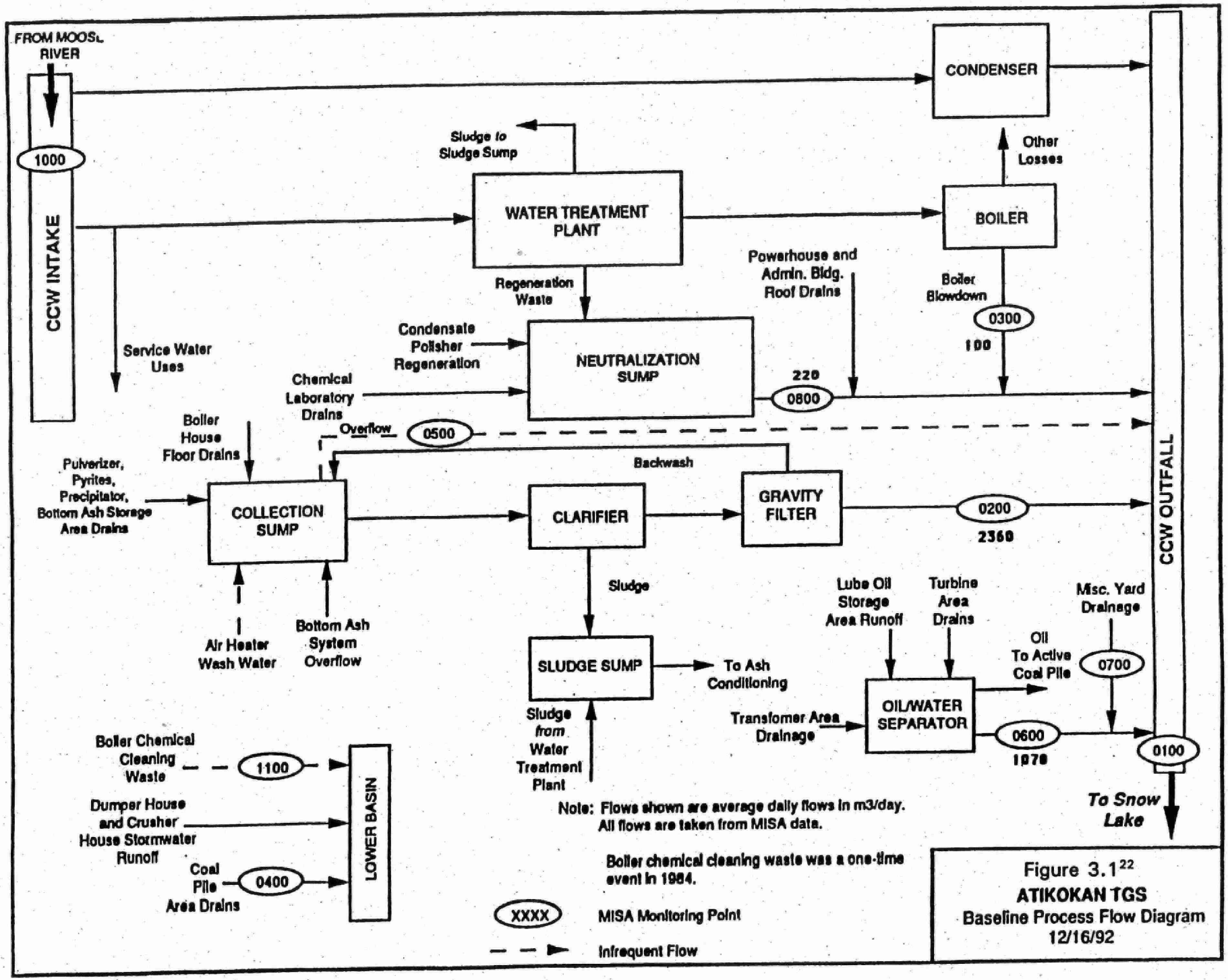


Figure 3.1[22]
ATIKOKAN TGS
Baseline Process Flow Diagram
12/16/92

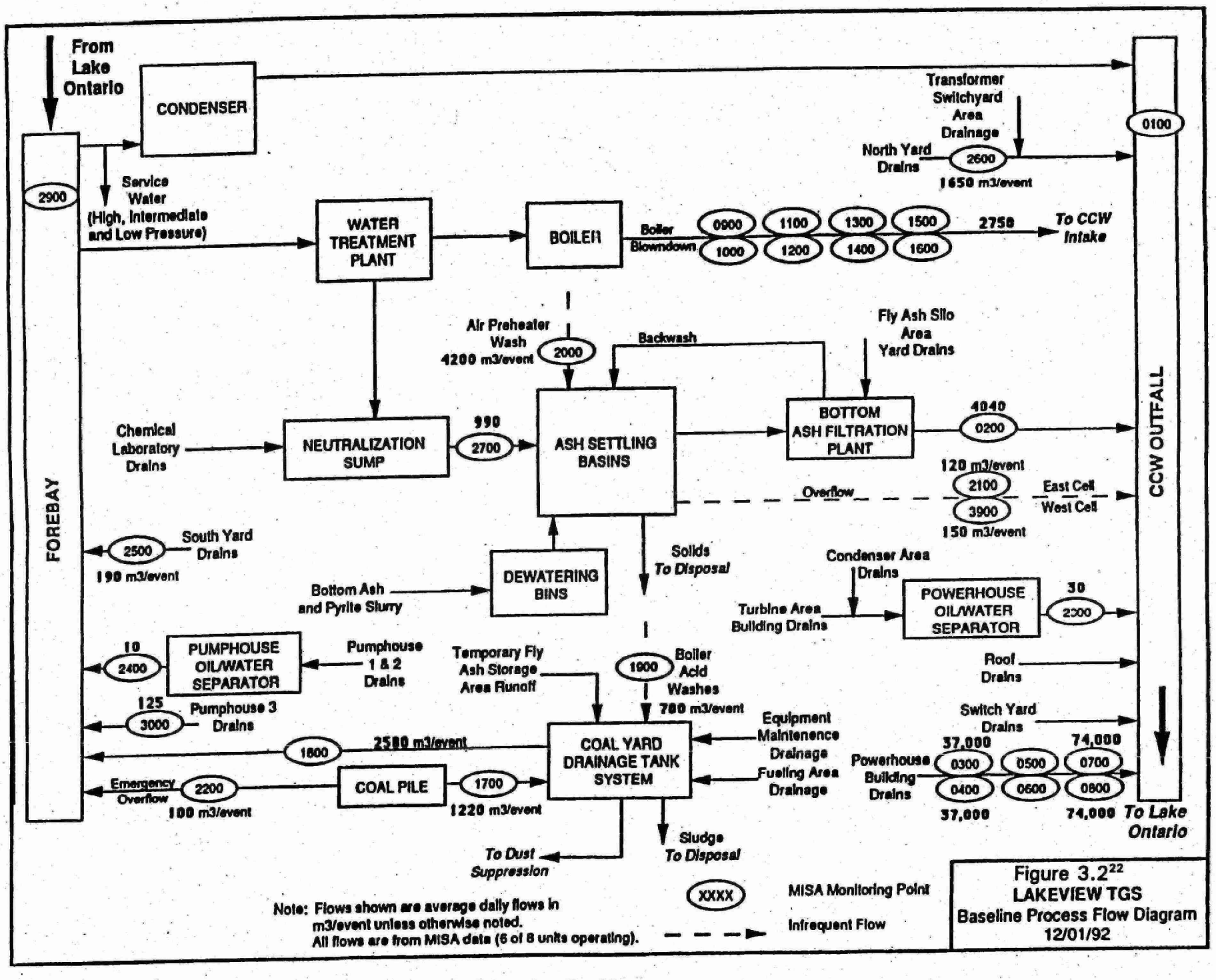


Figure 3.2[22]
LAKEVIEW TGS
Baseline Process Flow Diagram
12/01/92

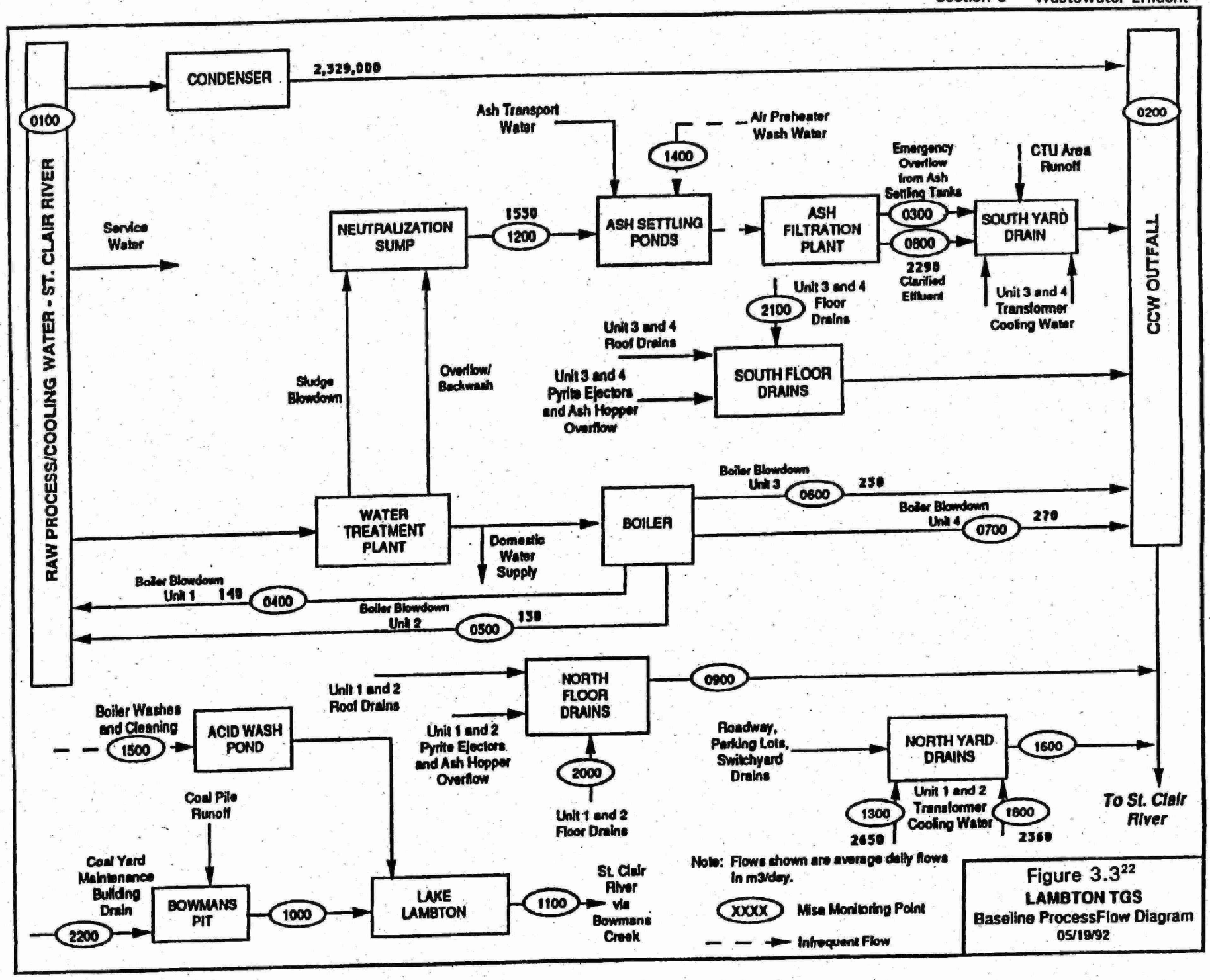


Figure 3.3[22]
LAMBTON TGS
Baseline ProcessFlow Diagram
05/19/92

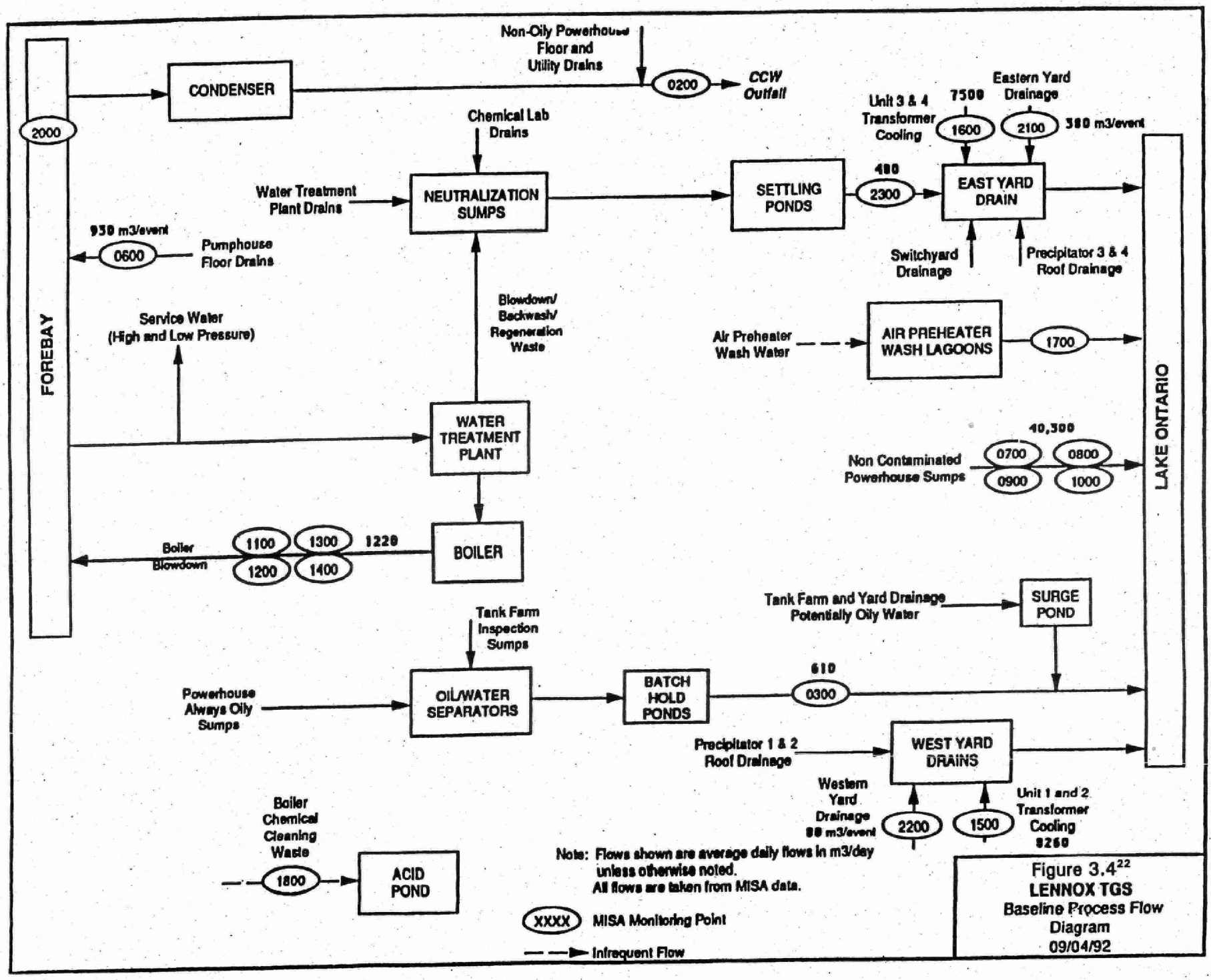


Figure 3.4[22]
LENNOX TGS
Baseline Process Flow Diagram
09/04/92

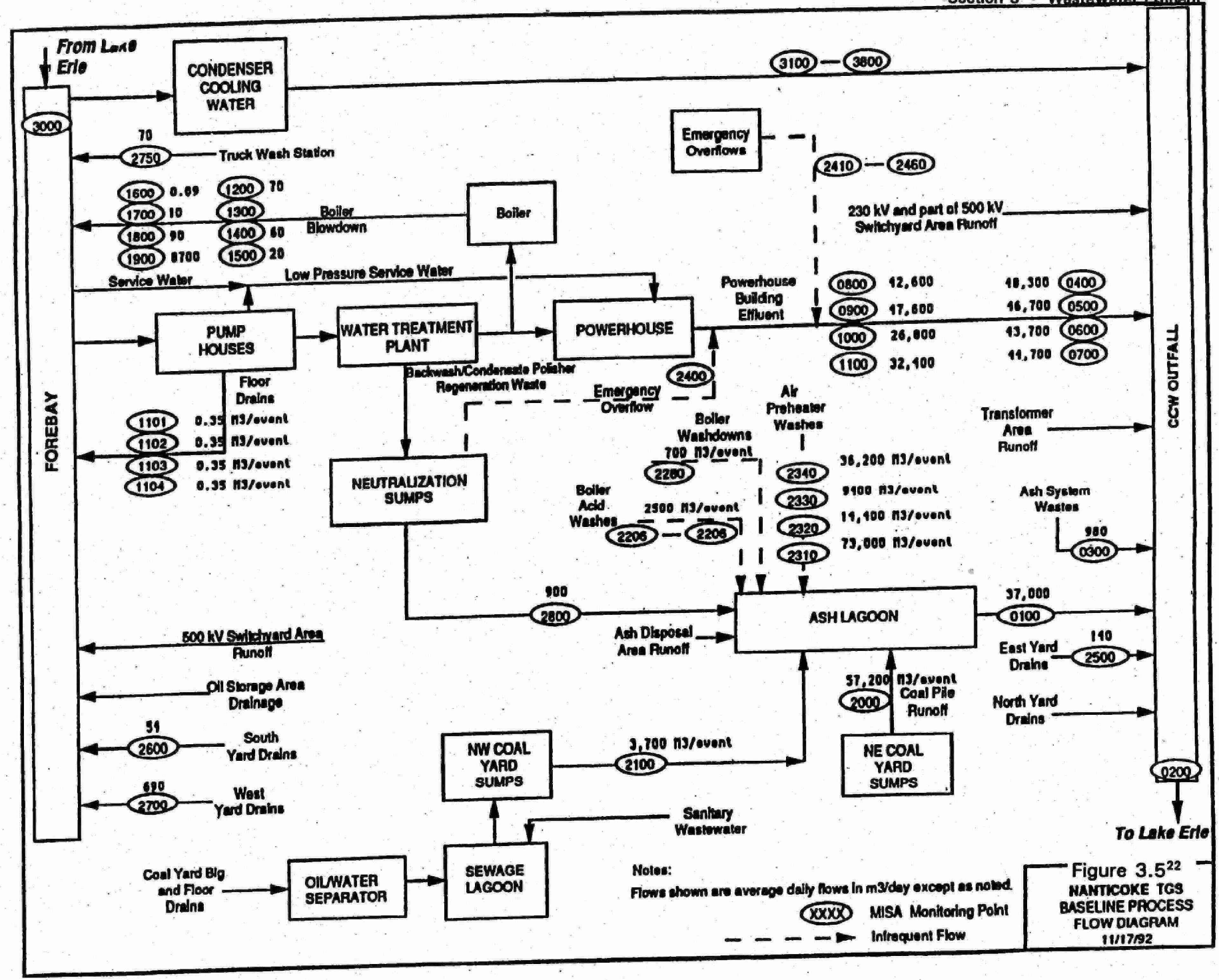


Figure 3.5[22]
NANTICOKE TGS
BASELINE PROCESS
FLOW DIAGRAM
11/17/92

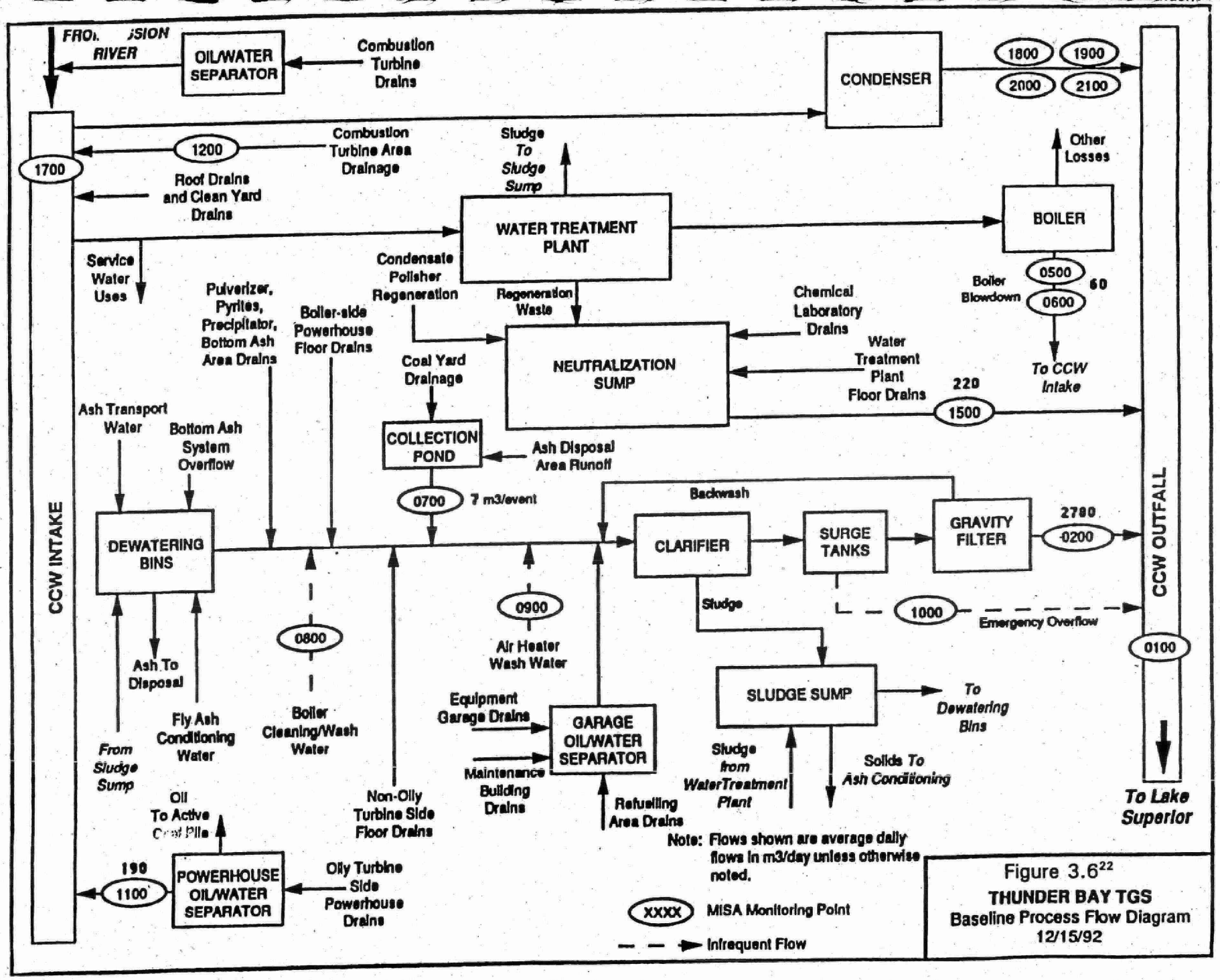


Figure 3.6[22]
THUNDER BAY TGS
Baseline Process Flow Diagram
12/15/92

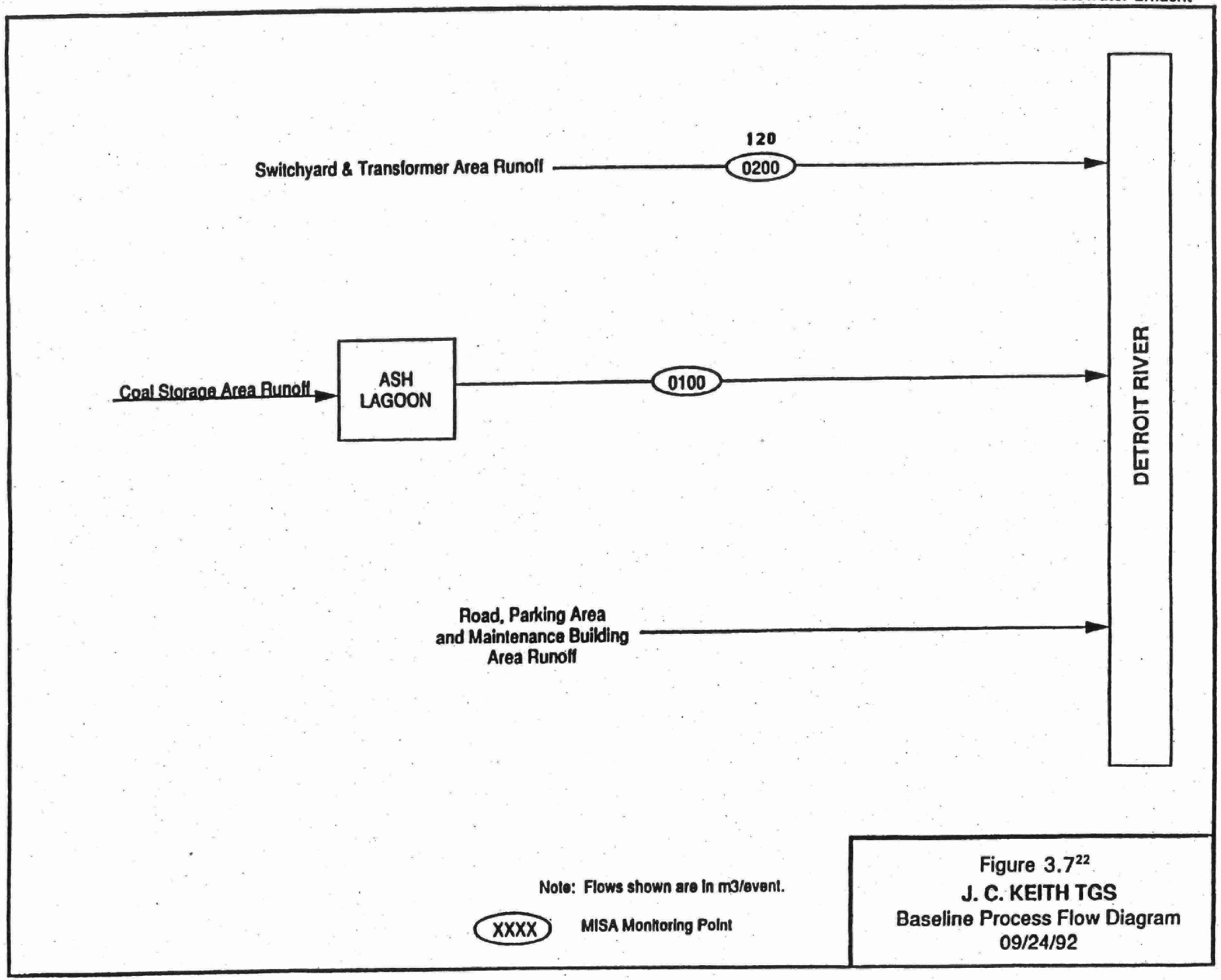


Figure 3.7[22]
J. C. KEITH TGS
Baseline Process Flow Diagram
09/24/92

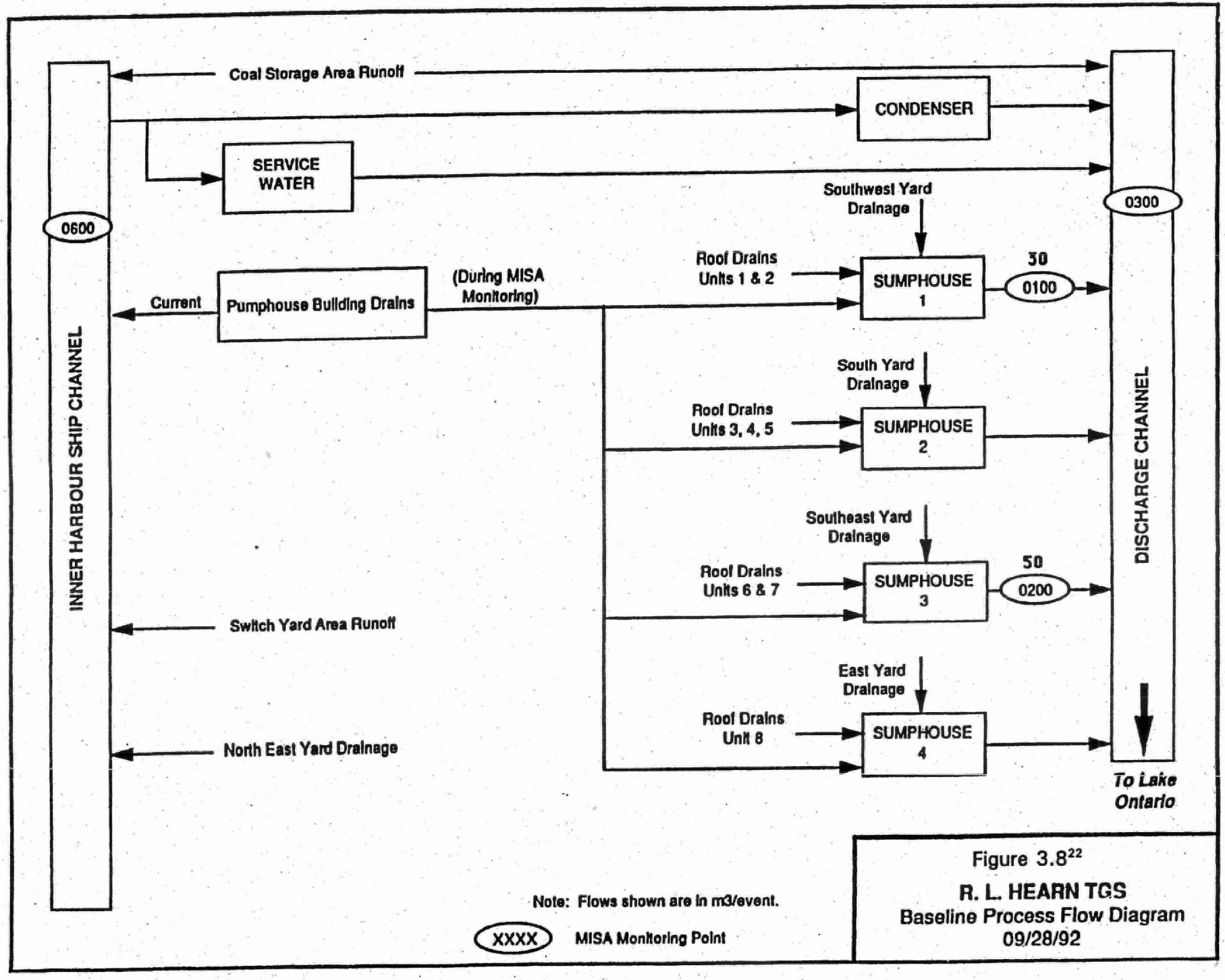


Figure 3.8[22]

R. L. HEARN TGS
Baseline Process Flow Diagram
09/28/92

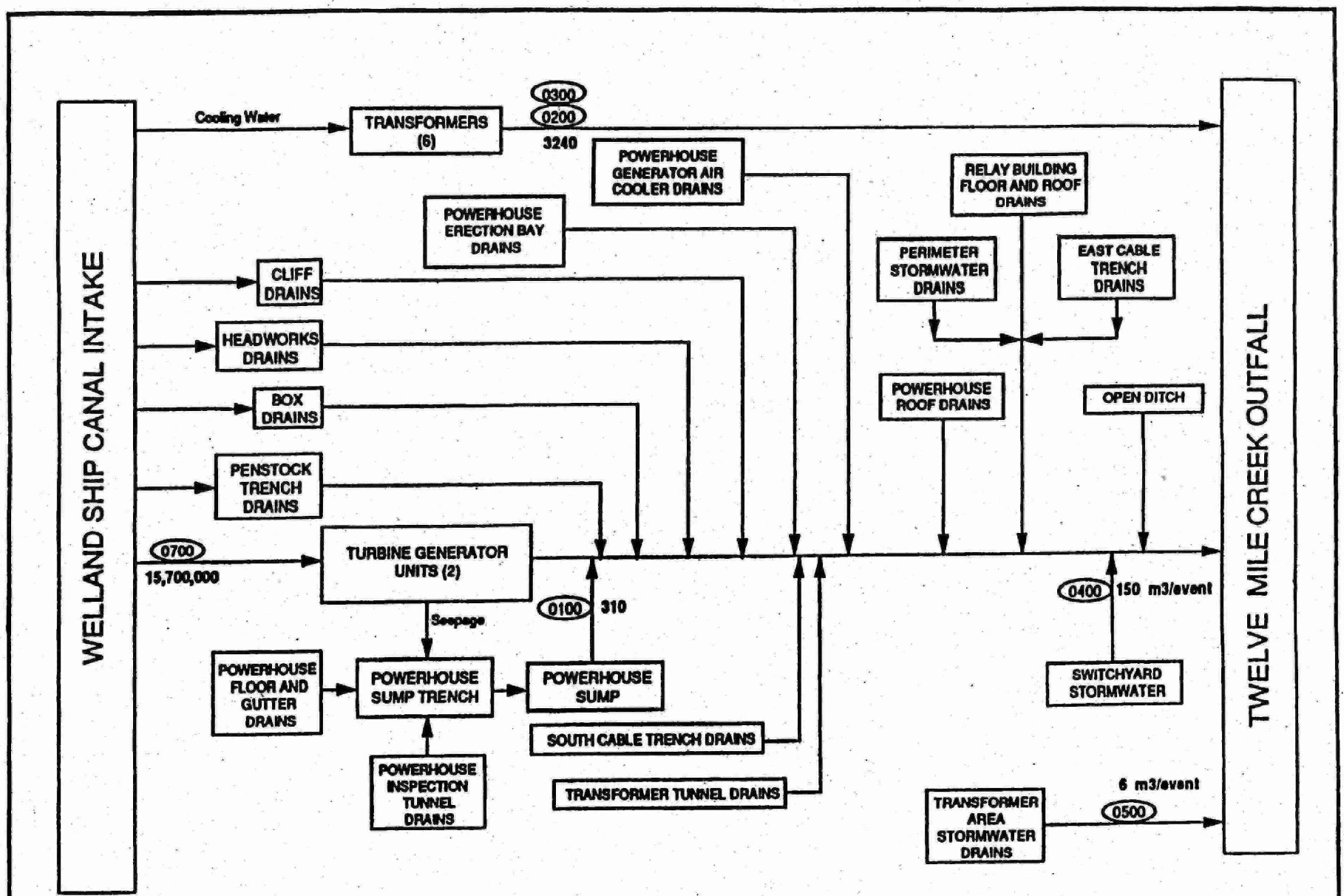


Figure 3.9[23]
DECEW FALLS HGS
BASELINE PROCESS FLOW DIAGRAM
08/03/92

Notes:

1) All flows are average daily in m3/day unless otherwise noted.
2) All flows indicated are taken from MISA data.

(XXXX) MISA monitoring point

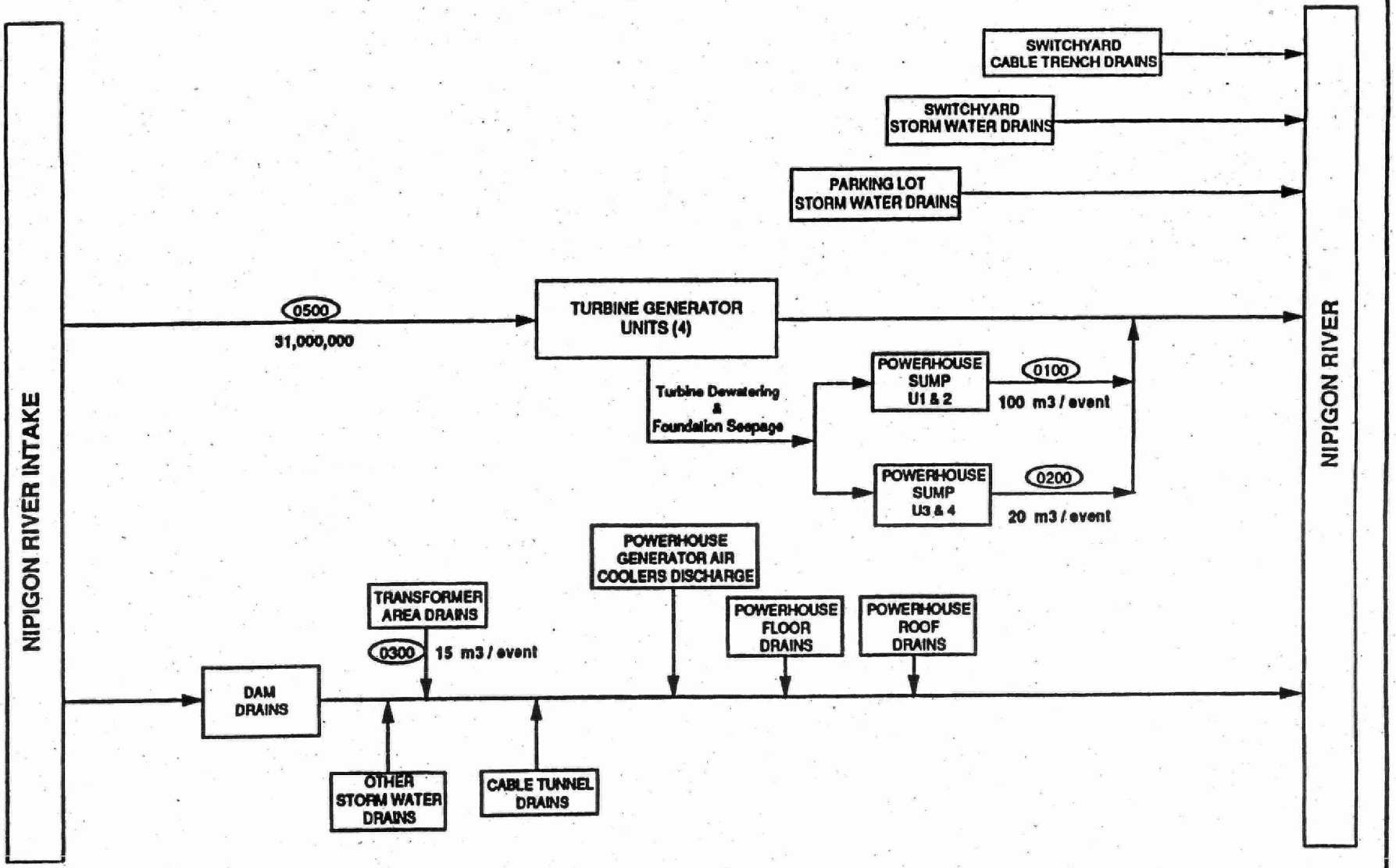


Figure 3.10[23]
PINE PORTAGE GS
BASELINE PROCESS FLOW DIAGRAM
08/03/92

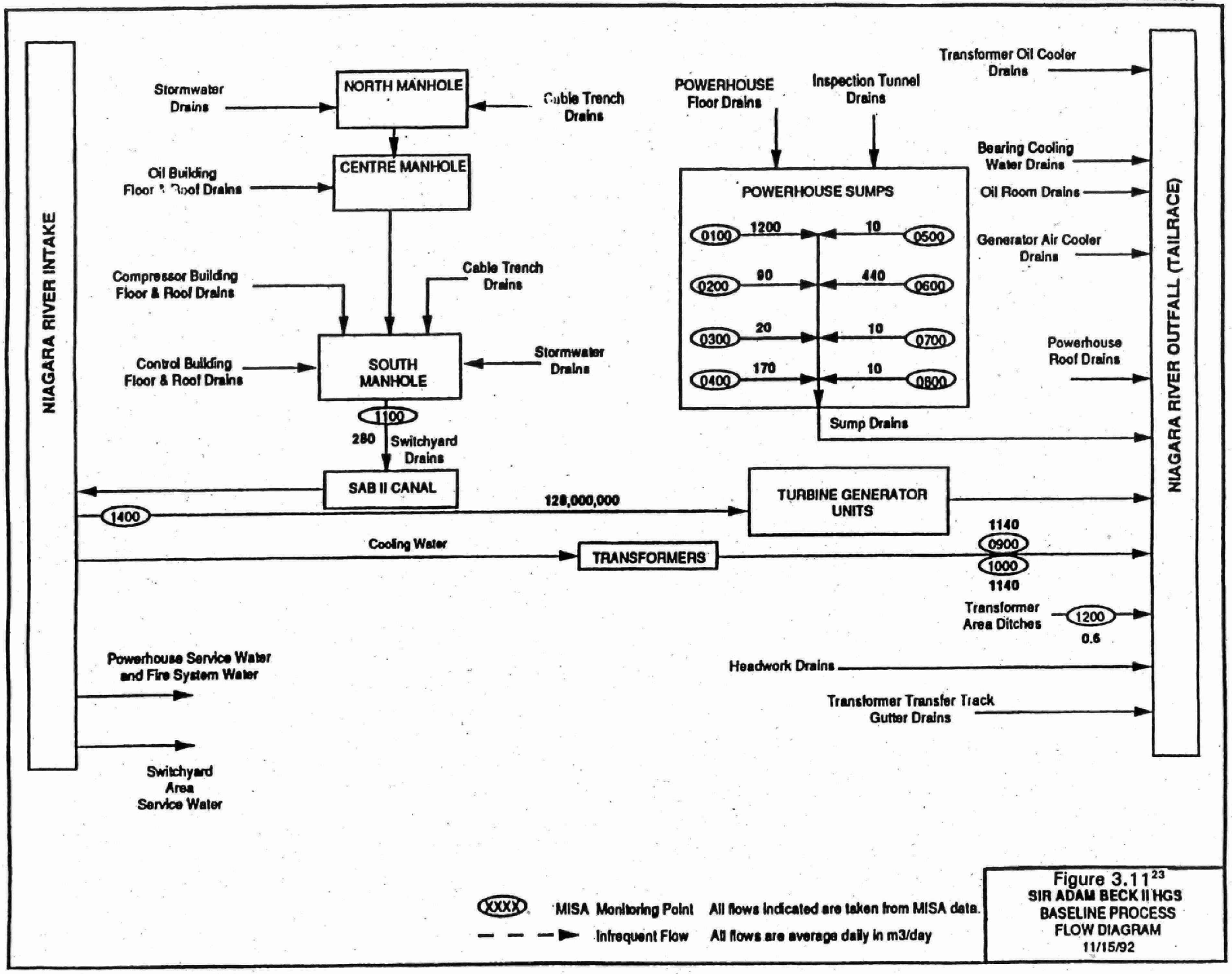


Figure 3.11[23]
SIR ADAM BECK II HGS
BASELINE PROCESS FLOW DIAGRAM
11/15/92

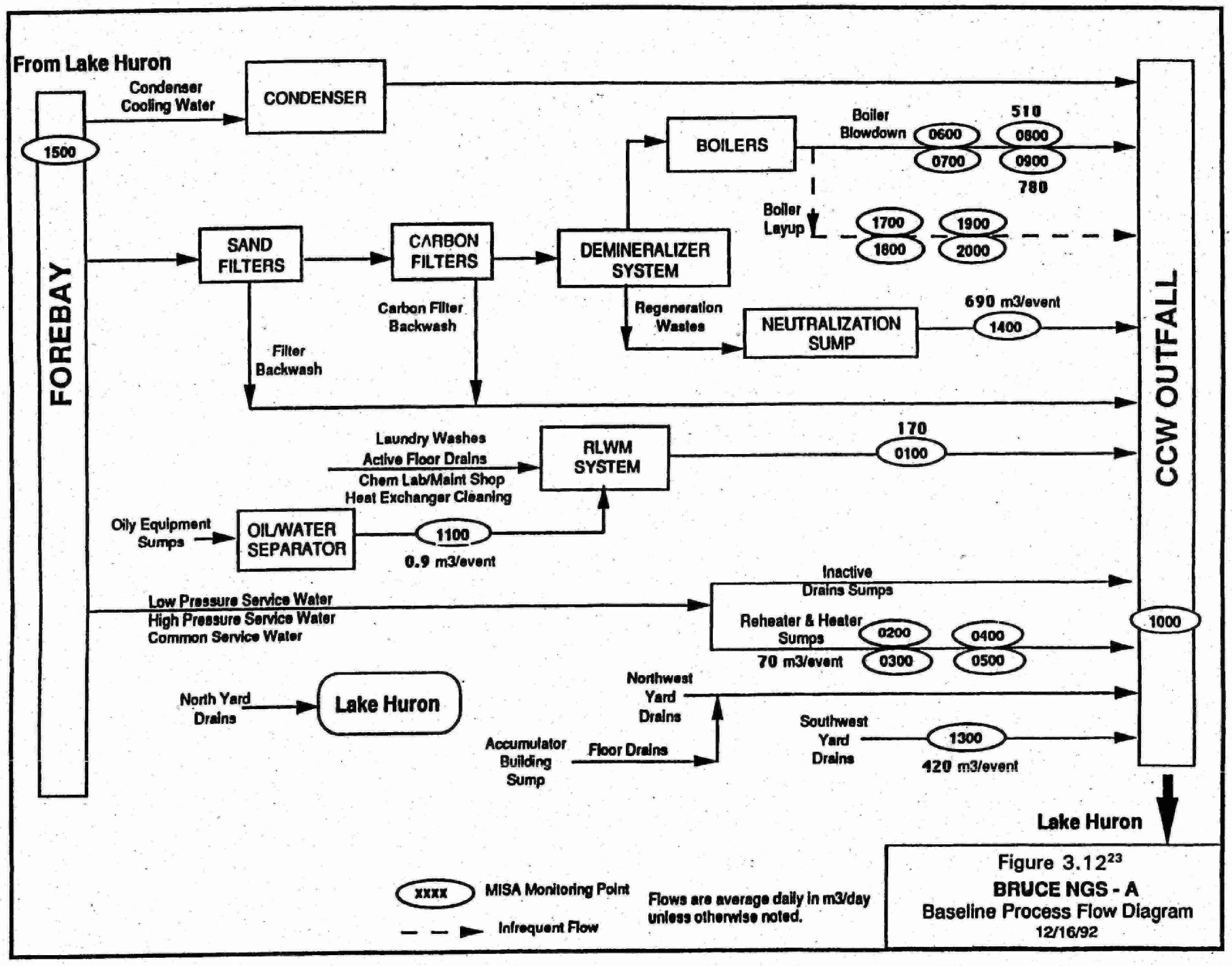


Figure 3.12[23]
BRUCE NGS - A
Baseline Process Flow Diagram
12/16/92

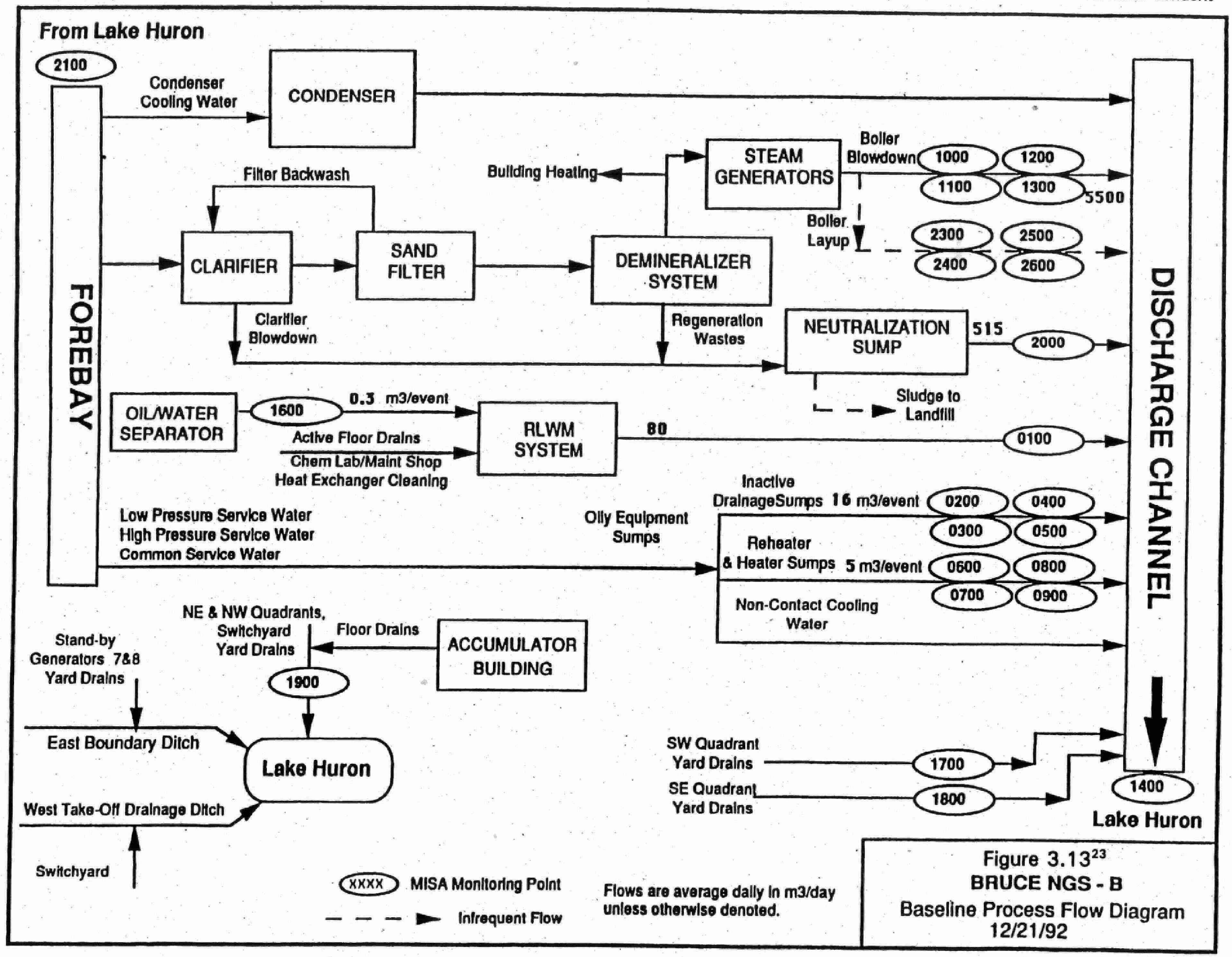
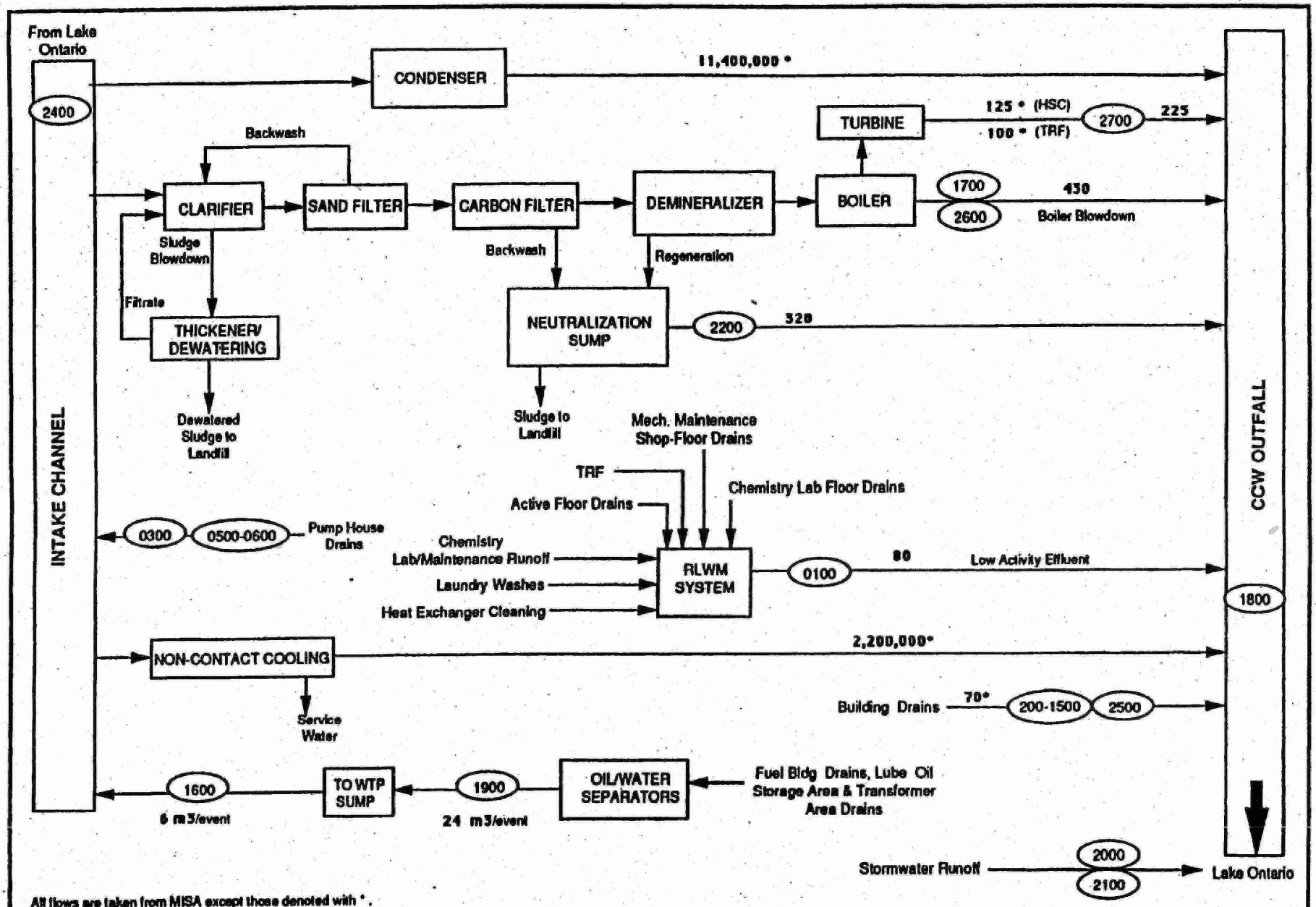


Figure 3.13[23]
BRUCE NGS - B
Baseline Process Flow Diagram
12/21/92



All flows are taken from MISA except those denoted with * .

Flows are average daily in m3/day unless otherwise denoted.

MISA data reflects monitoring information of the two operational Units 1 and 2. Units 3 is under commissioning. Unit 4 is under construction.

(XXXX) MISA Monitoring Point

Figure 3.14[23]
DARLINGTON NGS
Baseline Process Flow Diagram
12/09/92

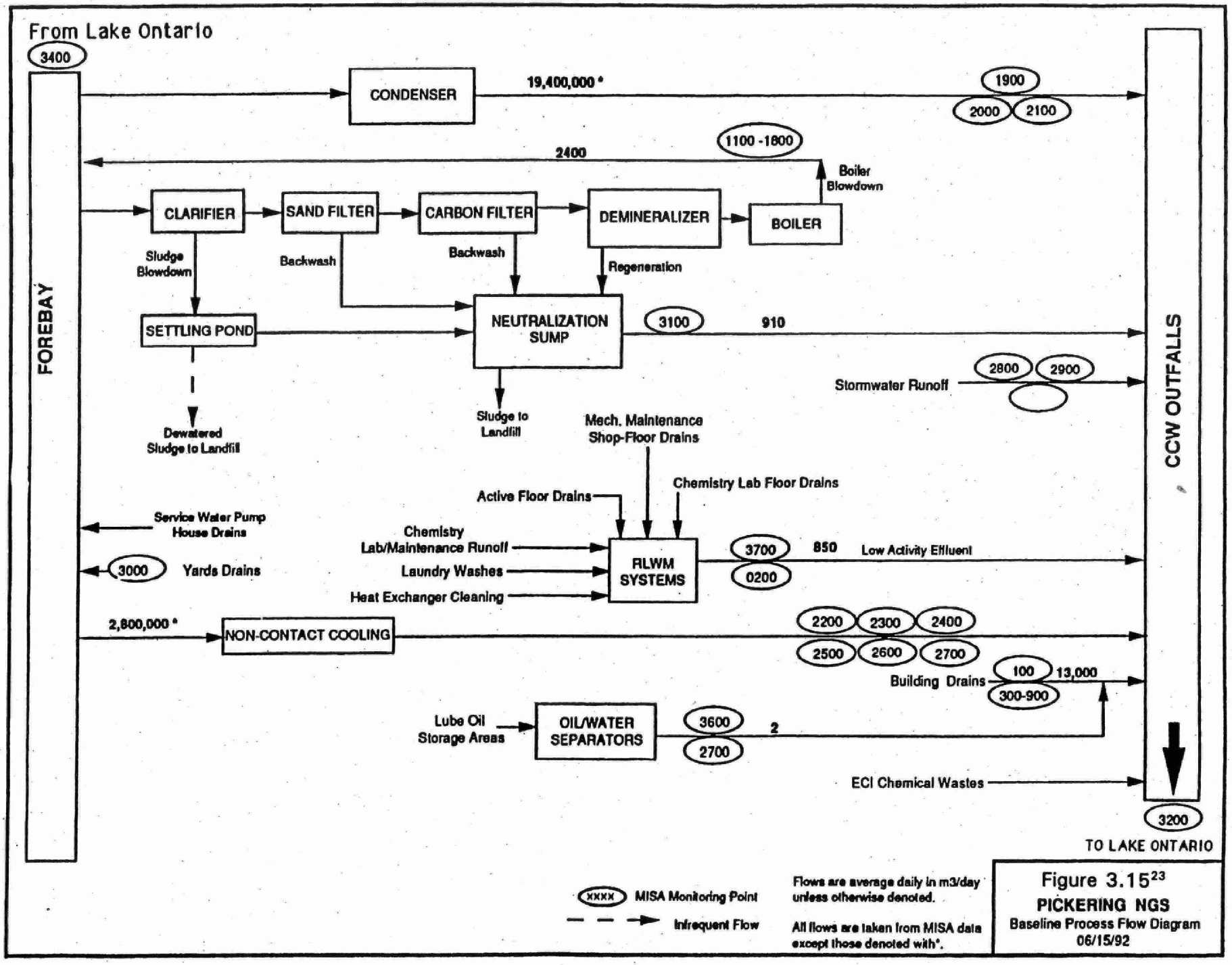


Figure 3.15[23]
PICKERING NGS
Baseline Process Flow Diagram
06/15/92

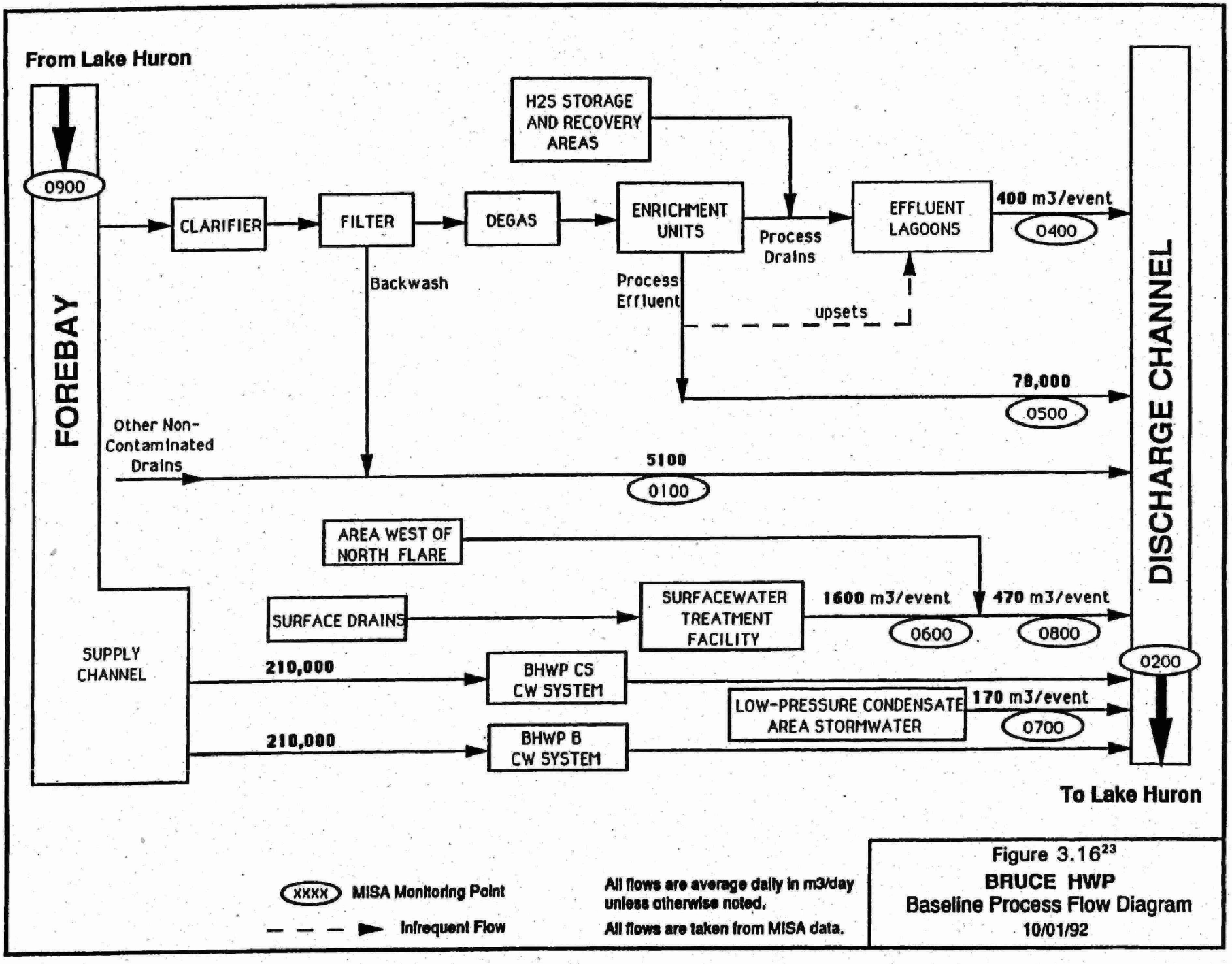


Figure 3.16[23]
BRUCE HWP
Baseline Process Flow Diagram
10/01/92

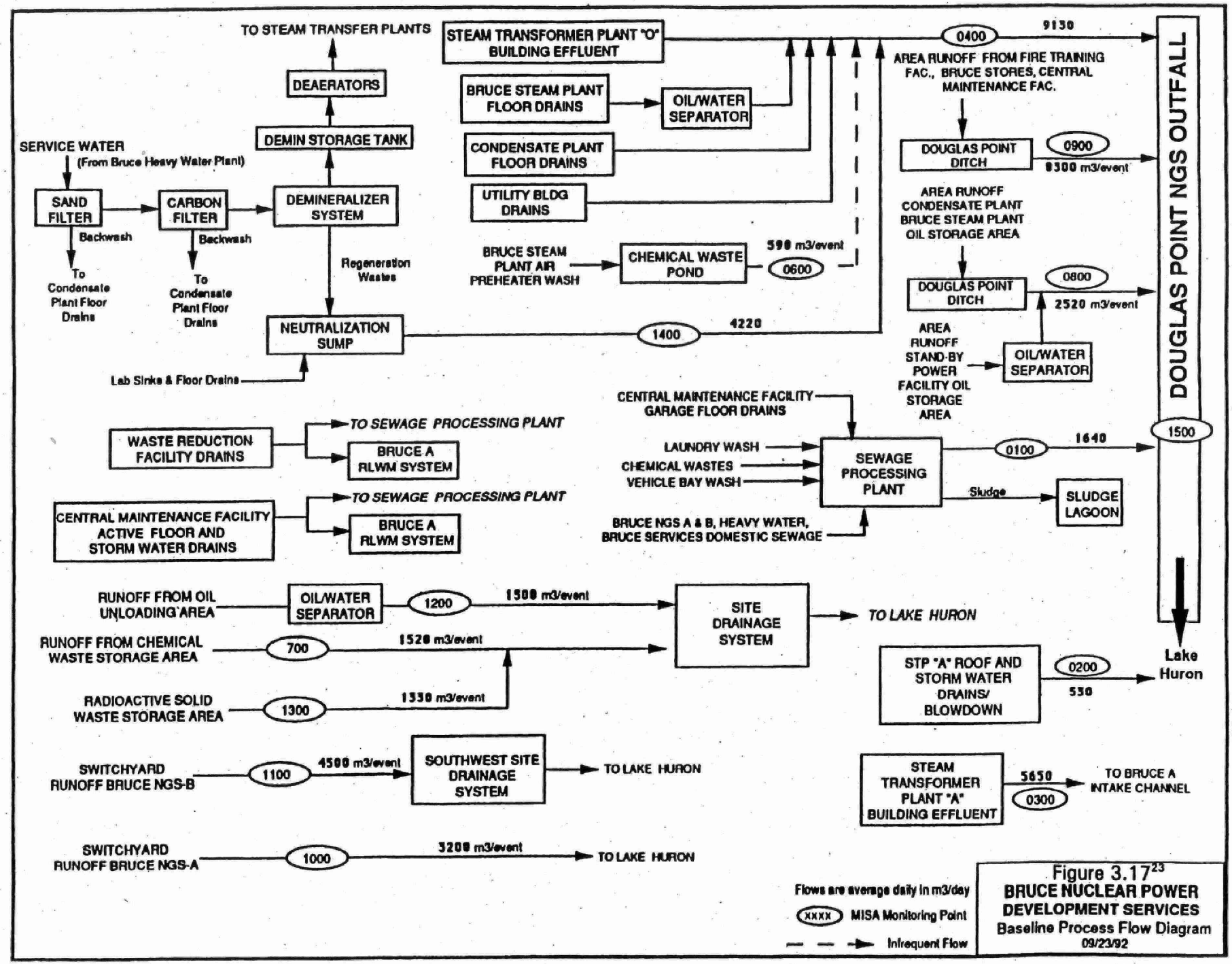


Figure 3.17[23]
BRUCE NUCLEAR POWER DEVELOPMENT SERVICES
Baseline Process Flow Diagram
09/23/92

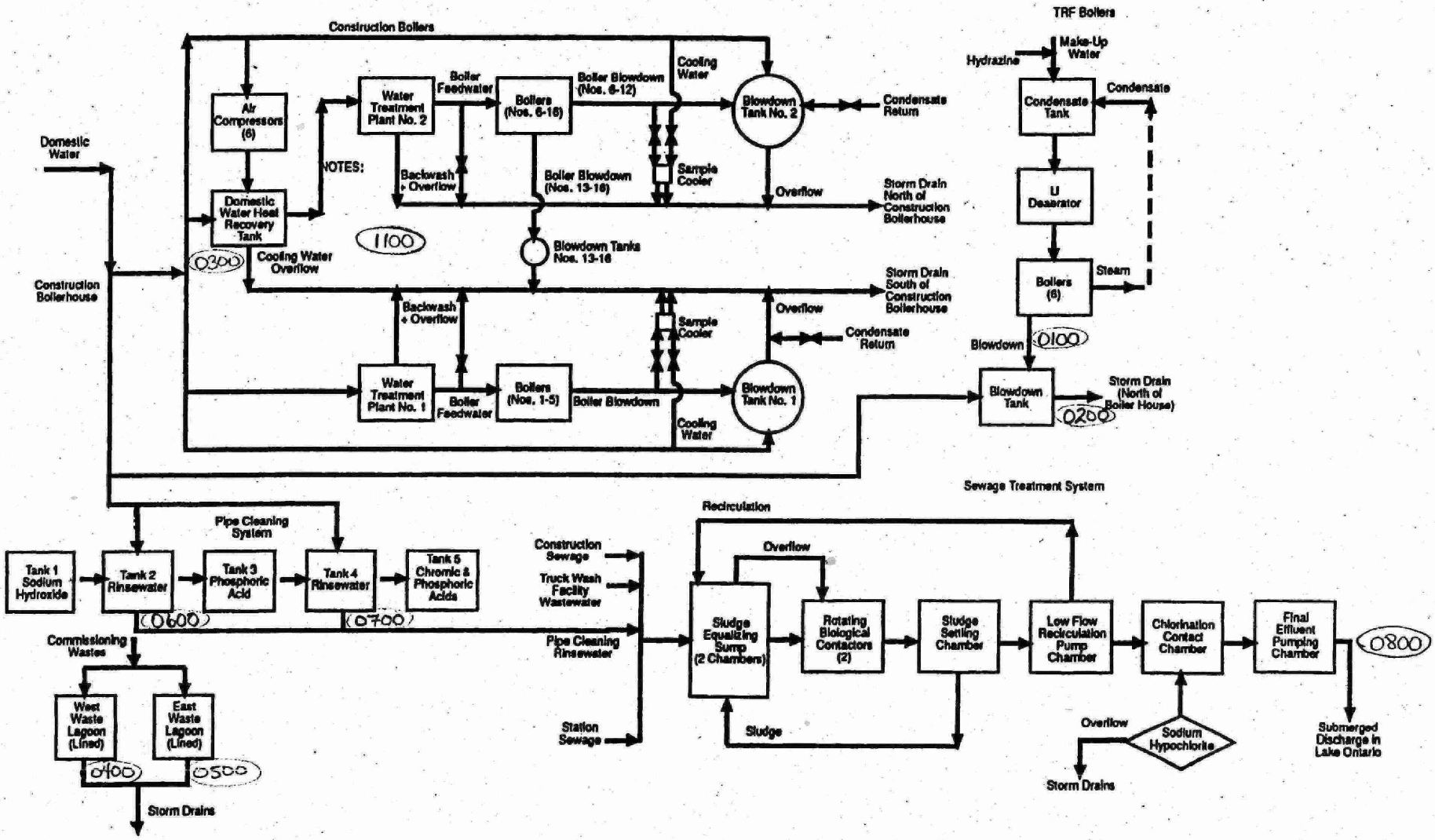


Figure 3.18[23]
Darlington Construction Site
Baseline Process Flow Diagram

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Section 4

Electric Power Generation Sector
Best Available Technology (BAT)

Section 4
Best Available Technology

Contents

Section			Page
4.0	**Best Available Technology**		1
	4.0.1	The BAT Subcommittee	1
	4.0.2	Study of BAT	1
	4.0.3	Development of BAT Options	2
4.1	**Goals of BAT Options**		5
	4.1.1	Best in Ontario Composite Option	5
	4.1.2	Treatment of Ash Quench and Boiler Seal Water Option	5
	4.1.3	Environment Canada Codes of Practice Effluent Quality Option	5
	4.1.4	No/Partial Discharge of Proven Toxic Process Streams	6
	4.1.5	Minimum Discharge of Process Streams Without Flue Gas Desulphurization or Cooling Tower for Main Condenser Cooling Water	7
	4.1.6	Minimum Discharge Option	7
	4.1.7	Best in Canada/Zero Discharge Option	7
4.2	**Description of BAT Options for Fossil Stations**		7
	4.2.1	Best In Ontario Composite	8
	4.2.2	Treatment of Ash Quench and Boiler Seal Water Option	10
	4.2.3	Environment Canada Codes of Practice Effluent Quality	11
	4.2.4	No Discharge of Proven Toxic Process Streams	11
	4.2.5	Minimum Discharge of Process Streams Without Flue Gas Desulphurization or Cooling Tower for Main Condenser Cooling Water	12
	4.2.6	Best in Canada/Zero Discharge Option	13
4.3	**Description of BAT Options for Hydraulic Stations**		23
4.4	**Description of BAT Options for Nuclear Stations**		23
	4.4.1	Best In Ontario Composite	23
	4.4.2	Environment Canada Codes of Practice Effluent Quality	25
	4.4.3	Partial Reduction of Toxic Process Streams	26
	4.4.4	Minimum Discharge Option	27
Description of BAT Options for Nuclear Associated Facilities			34
4.5	**Description of BAT Options for the Bruce Heavy Water Plant**		34
	4.5.1	Environment Canada Codes of Practice Effluent Quality	34
	4.5.2	Minimum Discharge Option	34
4.6	**Description of BAT Options for the BNPD Services**		34
	4.6.1	Environment Canada Codes of Practice Effluent Quality	34
	4.6.2	Minimum Discharge Option	35

Section 4
Best Available Technology - Contents (continued)

Section		Page
4.7	**Description of BAT Options for the Darlington Construction Site**	35
4.7.1	Environment Canada Codes of Practice Effluent Quality	35
4.7.2	Minimum Discharge Option	35
4.8	**Technology Option Costs and Attainable Loadings**	44
4.8.1	Costs of the BAT Options	44
4.8.2	Estimation of Loading Reductions	45
4.8.3	Loading Reductions - Fossil Stations	46
4.8.4	Loading Reductions - Nuclear Stations	47
4.8.5	Loading Reductions - Nuclear Associated Facilities	49
4.9	**Economic Assessment of BAT Options**	55
4.9.1	Cost Analysis of BAT Options	55
4.9.2	Abatement Cost Functions	56
4.9.3	Cost Effectiveness Analysis	59
4.9.4	Least Cost Implementation Strategy	60
4.9.5	Aggregate Abatement Scenarios	60
4.9.6	Financial Assessment: Corporate Financial Effects	61
4.9.7	Ontario Hydro Business Units	61
4.9.8	Economic Assessment Procedures	62
4.9.9	Results of the Cost-Effectiveness Analyses	62
4.9.10	Results of the Assessment of Potential Financial Effects of Postulated BAT Options	67
4.9.11	Business Unit Impacts	70
4.9.12	Economy-Wide Impacts of Potential MISA Abatement Investment	71
4.9.13	Financial Implications of the Draft EPGS Regulation	74
4.10	**References**	76

List of Tables

Table #		Page
4.1	Electric Power Generation Sector BAT Options	4
4.2	Environment Canada Codes of Practice Recommended Effluent Quality	6
4.3	Oil/Water Separator Installations at Fossil Stations	10
4.4	Estimated Flow Data and Other Information on Quench/Seal Discharges	11
4.5	Fossil Station Wastewater Streams and Current Treatment	14
4.6	Changes to Effluent Streams Under BAT Options for Fossil Stations	15
4.7	Identified Incremental Technologies by BAT Option for Fossil Stations	16
4.8	Nuclear Station Wastewater Streams and Current Treatment	27
4.9	Changes to Effluent Streams Under BAT Options for Nuclear Stations	28
4.10	Identified Incremental Technologies by BAT Option for Nuclear Stations	29

Table	List of Tables (continued)	Page
4.11	Nuclear Associated Facility Wastewater Streams and Current Treatment	36
4.12	Changes to Effluent Streams Under BAT Options for Nuclear Associated Facilities	37
4.13	Identified Incremental Technologies by BAT Option for Nuclear Associated Facilities	38
4.14	Predicted Effluent Loadings and Costs for Fossil Station BAT Options	51
4.15	Predicted Effluent Loadings and Costs for Nuclear Station BAT Options	53
4.16	Predicted Effluent Loadings and Costs for Nuclear Associated Facility BAT Options	54
4.17	Comparison of Aggregate BAT Options Annualized Costs and Contaminant Loadings	64
4.18	Sectoral Aggregate Cost-Effectiveness Ratios and Rank Ordering of BAT Options	65
4.19	Marginal Cost of BAT Options and Rank Ordering	66
4.20	MISA Cost Effects on Key Financial Indicators by Aggregate Abatement Scenarios and Subcategory	68
4.21	MISA BAT Option Cost Impacts on the Fossil Business Unit	69
4.22	MISA BAT Option Cost Impacts on the Nuclear Business Unit	70
4.23	Economy Wide Impacts of Potential MISA Induced Expenditures	71

Figure	List of Figures	Page
Fossil Stations Subcategory		
4.1	Best In Ontario Composite	17
4.2	Quench/Seal System Schematic	18
4.3	Environment Canada Design Codes of Practice Effluent Quality	19
4.4	No Discharge of Proven Toxic Process Streams	20
4.5	Minimum Discharge of Process Streams Without Flue Gas Desulphurization or Cooling Tower for Main Condenser Cooling Water	21
4.6	Best in Canada/Zero Discharge Option	22
Nuclear Stations Subcategory		
4.7	Best In Ontario Composite	30
4.8	Environment Canada Codes of Practice Effluent Quality	31
4.9	Partial Reduction of Toxic Streams Option	32
4.10	Minimum Discharge Option	33
Nuclear Associated Facility Category		
Bruce Heavy Water Plant		
4.11	Environment Canada Codes of Practice Effluent Quality	39
4.12	Minimum Discharge Option	40
Bruce Nuclear Power Development Services		
4.13	Minimum Discharge Option	41

List of Figures (continued)

Figure		Page
Darlington Construction Site		
4.14	Environment Canada Codes of Practice Effluent Quality	42
4.15	Minimum Discharge Option	43
4.16	Aggregate Abatement Cost Functions Comparing Total Annualized Cost of BAT Options with Initial and Final Loadings for TSS, Total Metals and All Contaminants from the Fossil Subcategory	56
4.17	Aggregate Abatement Cost Functions Comparing Total Annualized Cost of BAT Options with Initial and Final Loadings for TSS, Total Metals and All Contaminants from Ontario Hydro Nuclear Power Plants	57
4.18	Aggregate Abatement Cost Function Comparing Total Annualized Cost of BAT Options with Initial and Final Loadings for TSS, Total Metals and All Contaminants from the Nuclear Associated Facilities	58

4.0 Best Available Technology (BAT)

In June 1986, the Ontario Ministry of Environment introduced the Municipal Industrial Strategy for Abatement (MISA) program to achieve the ultimate goal of the virtual elimination of toxic contaminants in municipal and industrial discharges into Ontario's waterways. This goal is, in part, to be achieved by increasing the emphasis on wastewater control technology through the development of effluent limits based on the use of demonstrated Best Available Technology (BAT). This section provides a description of BAT identified for the Electric Power Generation Sector (EPGS) and the selection of preferred BAT options used as a basis for setting effluent limits.

4.0.1 The BAT Subcommittee

To identify BAT for the Electric Power Generation Sector (EPGS) a BAT subcommittee was formed which included members from Ontario Hydro and the Ontario Ministry of the Environment. The task of the BAT subcommittee was to recommend a number of BAT options which could be applied to sites in the Ontario EPGS to improve effluent quality. The BAT options developed would be assessed for effluent quality improvements attainable, cost effectiveness, and used as a basis for establishing effluent limits.

4.0.2 Study of BAT

It was decided, by the BAT subcommittee, to carry out the study of BAT for the EPGS in two parts.

For the first part of the study, the consultant, Bechtel Canada Inc. was retained by Ontario Hydro to conduct a global review of wastewater control in the Electric Power Generation Sector.

The Bechtel Canada Inc. study provided information in the following areas for use in setting effluent limits.

- a survey of the regulatory approach and treatment technologies used in various countries for power stations,
- an inventory of candidate treatment technologies best management practices and pollution prevention methods which could be applied to Ontario Hydro facilities,
- order of magnitude capital and operation, maintenance and administration costs for selected treatment technologies.

During the Bechtel study, eleven facilities consisting of five Canadian and six US sites were visited to investigate operating characteristics and applicability of wastewater control practices to Ontario Hydro Stations. Bechtel Inc. completed their final report[1] in June 1992.

In the second part of the study, a second consultant, AWT/Metcalf and Eddy Inc. (AWT/M&E) was retained by the Ontario Ministry of Environment and Energy to;

- Evaluate existing wastewater management and treatment practices in the Ontario Electric Power Generation Sector,
- Develop up to five BAT options for control of wastewater at each site in the Ontario Electric Power Generation Sector,
- Estimate the mass loading decrease expected from implementing technology specified under each BAT option,
- Estimate implementation costs for each of the Best Available Technology options.

The results of the second part of the BAT study, conducted by AWT/M&E on behalf of the MOEE, are contained in two reports completed in June 1993:

1) Evaluation of Best Available Technologies for the EPGS Subcategory A : Fossil and Hydraulic Stations[2]

2) Evaluation of Best Available Technologies for the EPGS Subcategory B: Nuclear/Other[3].

4.0.3 Development of BAT Options

AWT/M&E developed BAT options in consultation with the BAT subcommittee, and using information from their study of Ontario electric power facilities, MISA monitoring data and information supplied by the Bechtel BAT study.

From information on technologies in place and the inventory of available technologies identified in the Global Study, the AWT/M&E selected a smaller list of demonstrated technologies which could be applied to sites in the EPGS to improve effluent quality. Demonstrated technologies are those technologies for which data are available that can be used to predict, with a reasonable degree of confidence, the reliability of the technologies with respect to contaminant reductions and effluent variability at any plant in the sector.

The following criteria were used to select demonstrated technologies:

- the technology is used in the EPGS or in a similar industrial sector or sub-sector that produces effluents with similar characteristics,
- the technology can be retrofitted in at least some of the existing facilities with reasonable degree of confidence,
- the technology has been in commercial use for a significant time, generally at least a year,
- design/sizing and cost information is available for the technology or sufficient information is available to develop it.

When evaluating available technologies, the MOEE BAT Consultant considered:

- modifications to the production process to reduce or eliminate the formation or discharge of pollutants (ie. pollution prevention and/or zero discharge)
- chemical substitution
- in-plant control measures, including abatement of accidental spills
- best management practices (BMP's)
- water conservation
- effluent treatment technologies

Five BAT options were developed for fossil stations and four BAT options for nuclear stations. Two BAT options were developed for each of the nuclear associated facilities. BAT options for stations within each of the fossil station and nuclear station subcategories are generic because of the similar systems within each subcategory. The nuclear associated facility category is not a true category as it comprises three facilities which are unique; therefore, the BAT options developed are specific to each facility. The only common link between these facilities is that they all, in some way, provide a support function to the generation of nuclear power.

The method by which BAT technology was determined and the BAT options developed was consistent with procedures outlined in the MISA Issue Resolution Committee report[4]. The BAT options are

generally comprised of well established in-plant and end-of-pipe treatment technologies used in the power generating industry; recycle and reuse of process streams, where applicable; and waste minimization practices. The options are identified in table 4.1.

Table 4.1
Electric Power Generation Sector BAT Options

Subcategory	Option	Description
Fossil Subcategory Stations	I	Best in Ontario Composite
	IA	Treatment of Ash Quench and Boiler Seal Water
	II	Environment Canada Codes of Practice Effluent Quality
	III	No Discharge of Proven Toxic Process Streams
	IV	Minimum Discharge of Process Streams without Flue Gas Desulphurization (FGD) or Cooling Tower for Main Condenser Cooling Water
	V	Best in Canada/Zero Discharge Option
Nuclear Subcategory Stations	I	Best in Ontario Composite
	II	Environment Canada Codes of Practice Effluent Quality
	III	Partial Reduction of Toxic Process Streams
	IV	Minium Discharge
Nuclear Associated Facilities	I	Environment Canada Codes of Practice Effluent Quality
	II	Minium Discharge

In order to assess each of the BAT options, cost estimates for implementing each option were developed along with estimates of the reduction in contaminant loadings which could be achieved through the implementation of each option.

Recommendations for pollution prevention and best management practices which could further reduce wastewater volumes and quantities of contaminants released are discussed in the BAT reports but are not included in the cost of implementing the BAT options because the resulting effluent quality improvements could not be estimated.

With few exceptions, treatment of storm water effluent was not incorporated into any of the BAT options. Storm water effluent will be addressed under the effluent limits regulation by requiring each site to conduct a storm water control study.

4.1 Goals of the BAT Options

The technologies prescribed under each BAT option were selected as required to meet the option's goal (eg. minimum discharge), each of which is described in the following sections.

4.1.1 Best in Ontario Composite Option

Best in Ontario options were prepared for both the fossil station and nuclear station subcategories. This option was developed by reviewing the treatment or wastewater management practices used for a particular effluent stream at each station within a subcategory and selecting the best practice for the stream. A composite station treatment system was then produced by combining the best practices from all sites. Implementation of this option would insure that all generating stations employed technologies for control of effluent quality to match the best currently in place in Ontario.

4.1.2 Treatment of Ash Quench and Boiler Seal Water

The option for treatment of ash quench and boiler seal water is specific to the fossil stations subcategory. The goal of the option is to provide treatment for ash hopper quench and seal water effluent which is currently discharged untreated at three of the five operating coal fired stations. These streams were identified as contributing the bulk of the untreated TSS loading from the fossil subcategory.

4.1.3 Environment Canada Codes of Practice Option

An Environment Canada Codes of Practice Option was developed for the fossil and nuclear subcategories and all sites in the nuclear associated facility category.

The goal of the Environment Canada Codes of Practice Option is to remove contaminants from process effluents which exceed the recommended effluent quality criteria specified under the Environment Canada Design Codes of Practice for Steam Electric Power Generation[5].

The Environment Canada Design Codes of Practice for Steam Electric Power Generation contain recommended practices and design opportunities to reduce the discharge of contaminants from new or modified power generating stations. Appendix E of the Codes contains effluent quality criteria that should be met for all process effluents before discharge to cooling water or directly to receiving waters. Concentration limits are specified for the ten parameters listed in table 4.2.

The BAT subcommittee agreed that treatment systems could be designed and/or management practices implemented to meet the effluent qualities recommended under the Environment Canada Codes of Practice.

Table 4.2
Environment Canada Codes of Practice
Recommended Process Effluent Quality

Parameter	Recommended Effluent Quality	Units
pH	6.5 - 9.5	
TSS	$\leq$ 25	mg/L
Oil & Grease	$\leq$ 15	mg/L
Chromium (total)	$\leq$ 0.5	mg/L
Chromium (hexavalent)	$\leq$ 0.05	mg/L
Copper	$\leq$ 0.5	mg/L
Nickel	$\leq$ 0.5	mg/L
Zinc	$\leq$ 0.5	mg/L
Iron	$\leq$ 1.0	mg/L
Total Residual Chlorine	$\leq$ 0.2	mg/L

Notes:
1) Metal concentrations are for total dissolved and undissolved solids.
2) Values apply to average weekly composite samples.

4.1.4 No/Partial Discharge of Proven Toxic Process Streams

The goal of this option is to eliminate the discharge of all effluent identified as toxic during the MISA monitoring period. A no discharge of proven toxic process streams option was developed for the fossil category whereas only a partial discharge of proven toxic process streams option was developed for the nuclear station subcategory. Only partial reuse of toxic

streams was considered under the option for nuclear stations due to radiation concerns associated with the recycle of potentially radioactive effluent. A Partial Reduction of Toxic Streams Option was not developed for nuclear associated facilities because those streams which were found toxic are most effectively controlled using measures prescribed under the minimum discharge option.

4.1.5 Minimum Discharge of Process Streams without Flue Gas Desulphurization (FGD) or Cooling Tower for Main Condenser Cooling Water

This option is specific to the fossil stations subcategory. The goal of the option is to minimize the discharge of all process effluents.

4.1.6 Minimum Discharge Option

Minimum discharge options were developed for the nuclear station subcategory and each of the nuclear associated facilities. The goal of this option is to reduce contaminant loadings through maximum water reuse.

4.1.7 Best in Canada/Zero Discharge Option

The Best in Canada/Zero Discharge option is specific to the fossil stations subcategory. Fossil stations were the only facilities where zero discharge of all effluent (process and non-process) was deemed feasible.

The following sections describe each of the BAT options developed. BAT options for fossil stations are described under section 4.2, nuclear station BAT options are described under section 4.3 and nuclear associated facilities under section 4.4.

4.2 Description of BAT Options for Fossil Stations

The five BAT options developed for the fossil stations subcategory are described briefly below. A more detailed description and discussion can be found in the report on the Evaluation of Best Available Technologies for the EPGS Subcategory A : Fossil and Hydraulic Stations[2]. Each stream, as monitored during the MISA monitoring period, is described under section 3 of this report.

4.2.1 Fossil Stations Option I: Best-in-Ontario Composite

A block diagram of this option is presented in Figure 4.1. The handling of each process effluent under the Best in Ontario option is described below.

Neutralization Sump

The Best-in-Ontario technology for neutralization sump effluent is based on practices at Lakeview and Lambton generating stations where neutralization sump effluent is treated with ash transport water using pH adjustment, settling and filtration. Also at Lambton, two mixers are used in the neutralization sump to aid in neutralization prior to discharge.

Ash Transport Systems

The Best-in-Ontario technology for bottom ash transport systems are the current systems in place at Atikokan, Lakeview, Lambton and Thunder Bay. Nanticoke has a unique lagoon system which received both fly ash and bottom ash during the monitoring period but has recently (1992/93) converted to a dry fly-ash system which is similar to other stations. The submerged chain conveyor system used at Atikokan was judged to be equivalent to the bottom ash hopper sluicing systems used at the other stations.

Coal Pile Run Off

Coal pile run off at Lakeview station is collected in drainage ponds and neutralized with lime. Some run off is used for dust control on the coal pile. Because of recycle of coal pile run off, Lakeview is considered a Best-in-Ontario practice. However, the Best-in-Ontario BAT option assumes co-treatment of coal pile run off in the ATWTS.

Ash Pile Run Off

Ash Pile run off collection and treatment for solids removal by settling and filtration is conducted at the Thunder Bay facility. This method of treatment is preferred over discharge to a pond followed by direct discharge since fine solids may not be removed.

Boiler blowdown

None of the Ontario Hydro stations collect or reuse boiler blowdown. The Atikokan facility discharges blowdown through a flash tank to the condenser cooling water stream. The other stations discharge boiler blowdown directly to the condenser cooling water stream. The current practices in Ontario for boiler blowdown are considered equivalent.

Maintenance/Cleaning Wastes

Boiler Tubes, Waterside: An acidic wastewater is normally produced by waterside boiler tube cleaning operations. The Best-In-Ontario practice for this wastewater is conducted at Lambton station where the boiler tube acid wash water is treated with sodium hydroxide in a clay-lined pond. Similar treatment is also carried out at Lakeview.

Boiler Tubes, Fireside: At Atikokan and Thunder Bay, fireside cleaning effluent is discharged to the facilities' ash treatment system, where particulate matter is removed by settling and filtration. This practice is considered to be the Best-In-Ontario.

Boiler Lay-up Waste: During unit shut down, off-line boilers are normally filled with treated water containing various corrosion inhibitors such as ammonia and hydrazine. When the boiler is put back on-line, the lay-up waste must be drained. Currently, all Ontario Hydro stations discharge lay-up wastes to the condenser cooling water channel.

Air Preheater: Best-In-Ontario practice for waste streams generated during preheater cleaning is their treatment in the ash transport water treatment or ash filtration plant including pH adjustment. This practice is conducted at all stations except Nanticoke, where the wastes are discharged to the ash lagoon.

Condenser Tubes: Atikokan uses an off-line condenser tube cleaning process (using brushes). The on-line "Taproggee System" utilizing sponge balls used at Thunder Bay is considered an equivalent practice. No waste water is produced in either case.

Building Effluent

Best-In-Ontario practice for building effluent from floor drains includes collection and treatment by an oil/water separation process prior to discharge. Table 4.3 summarizes current use of oil/water separators at fossil stations on various

drains. Nanticoke and Thunder Bay have no oily water separators in place.

Table 4.3
Oil/Water Separator Installations at Fossil Stations

Station	Pump House Drains	Boiler House Drains	Turbine Hall Drains	Maintenance Garage Drains
Atikokan	No	No	Yes	No
Lakeview	Yes	Yes	No	No
Lennox	No	Yes	Yes	Yes
Lambton	No	No	Yes	Yes

4.2.2 Fossil Stations Option IA: Treatment of Ash Quench and Boiler Seal Water

Bottom ash quench water and boiler seal water effluent streams were not monitored as process streams under the MISA effluent monitoring regulation and therefore were also not included in the BAT options developed by M&E/AWT.

This issue was brought to the attention of the JTC (end of 1992) and a decision was made to develop a separate option using Ontario Hydro expertise in consultation with the BAT subcommittee. The Ministry was assured of Ontario Hydro's commitment to achieve effluent quality equal to the performance of the ash transport water treatment system for these discharges[6].

The option developed provides treatment for bottom ash quench water and boiler seal water at Nanticoke, Lakeview and Lambton who currently discharge these untreated wastewaters to the condenser cooling water through floor drains. Treatment by clarification and filtration is currently inplace for bottom ash quench water and boiler seal water only at Atikokan and Thunder Bay.

Table 4.4 summarizes the pertinent flow information on ash quench and boiler seal water discharges used in developing this option. Concentration data for total suspended solids were taken from recent (1993) monitoring by Ontario Hydro. Combined quench/seal water TSS concentrations were estimated at an average of 40 mg/L. Figure 4.2 provides a schematic of a typical quench/seal water system (from Nanticoke TGS) showing the source of these wastewaters.

Table 4.4
Estimated Flow Data and Other Information on Quench/Seal Discharges

Station	Lakeview Units 1 & 2	Lakeview Units 5 & 6	Lambton	Nanticoke
Combined Quench and Seal Overflows per unit	1353 m^3/d	4579 m^3/d	2289 m^3/d	2508 m^3/d
# Units	2	2	4	8
# Effluent/Unit	2	2	2	1

Notes:
- Flow estimated by Ontario Hydro using design flow data and ultrasonic flow measurement.
- A more detailed analysis of flow characteristics will be performed during the design phase of quench/seal water treatment systems
- Quench and seal waters discharged through a separate overflow pipes at Lakeview and Lambton but through a common pipe at Nanticoke.

4.2.3 Fossil Stations Option II: Environment Canada Codes of Practice Effluent Quality[5]

This option involves the collection of the various streams identified as containing parameters at concentrations above the effluent quality recommended by the Environment Canada Codes of Practice in lined equalization ponds, followed by physical/chemical treatment technologies. Based on a review of the monitoring data, it was found that the streams that may contain one or more of the parameters in excess of the above criteria include the neutralization sump effluent, potentially contaminated building effluent, coal pile run off, ash transport water, and equipment cleaning wastes. The physical/chemical treatment technologies employed are chemical addition, precipitation, clarification, filtration and pH adjustment. Effluent from oily water drains are pre-treated by oily water separators prior to being directed to the equalization ponds. Filter backwash is recycled to the clarifier and sludge is dewatered and disposed of appropriately. A block flow diagram of this option is presented in Figure 4.3.

4.2.4 Fossil Stations Option III: No Discharge of Proven Toxic Process Streams

Effluents found to be toxic (see Appendix C) during MISA monitoring include the neutralization sump effluent, boiler blowdown and ash transport water. Based on the toxicity data, the toxic properties of ash transport water appear to be reduced through treatment in the Ash Filtration Plant or the Ash Transport Water Treatment Plant. Nanticoke is the only station that does not currently employ an ash transport water filtration

system. By incorporating pH adjustment and recycle capabilities on the ash filtration plant effluent, the consultant believes that the potential for toxic discharge will be reduced even further.

During normal operation, a flash tank allows reuse of boiler blowdown. Flash tank steam is reused in the condensate/feedwater system deaerator. The liquid fraction is also recycled to the water treatment plant softeners via heat exchangers. During start-up, the blowdown may be treated in the ash filtration plant (AFP). Neutralization sump effluent is treated with ash collection pond wastes. The AFP provides precipitation of metals, filtration and pH adjustment prior to discharge. A block flow diagram for this option is presented in Figure 4.4.

4.2.5 Fossil Stations Option IV: Minimum Discharge of Process Streams Without FGD or Cooling Tower for Main Condenser Cooling Water

This BAT option minimizes discharge of effluent by incorporating a cooling tower for closed loop cooling of power station auxiliary equipment and treatment and reuse of process streams. Minimum discharge of treated process water and floor drain effluent is included to maintain the overall plant water balance, as necessary.

The major features of this option are:

- condensate polisher to minimize boiler blowdown
- recycle of boiler blowdown in the steam cycle and discharge of liquid boiler blowdown to the soft water pond for cooling tower make-up
- treatment of cooling tower and regeneration wastes in an ultrafiltration (UF), reverse osmosis (RO) and evaporator train
- water consumption via a cooling tower (evaporative losses) for closed loop cooling water used in heat exchangers

Treatment of coal pile run off, ash pile run off, equipment cleaning and evaporator waste brine before discharge is provided in a clarifier/thickener and a soft water pond. Lime and polymer are added to the clarifier feed to aid in solids removal. The soft water pond provides surge capacity to reduce discharge requirements resulting from short term fluctuations in the water balance. A media filter is provided for final polishing prior to any discharge from the soft water pond.

This option is the intermediate step between no discharge of proven toxic process streams and the Best-in-Canada zero discharge option. A block flow diagram of this option is presented in Figure 4.5.

4.2.6 Fossil Stations Option V: Best-In-Canada/Zero Discharge Option

The BAT consultant selected the Shand station in Saskatchewan as the model for the Best-In-Canada option for the fossil fuelled subcategory. Shand operates as a zero discharge facility.

As discussed in the AWT/M&E BAT report, the adaptation of the Shand design to the Ontario stations required a modified approach. The Shand station uses a cooling tower, a 50% LIFAC (Limestone Injection into the Furnace and Activation of unreacted Calcium) flue gas sulphur dioxide removal system, and natural evaporation as net water users to aid in the zero discharge water balance. Due to different meteorological conditions in the province of Ontario, relying on natural evaporation is not feasible. In addition, most Ontario Hydro stations are not expected to have flue gas desulphurization systems (FGD). Where installed, the FGD's are likely to be wet, forced oxidation systems designed to provide commercial grade of gypsum. The net water consumption is expected to be significantly less than a dry type FGD.

A raw water pond is used to collect all wastewater streams that are suitable for cooling tower feed water but first require treatment for removal of dissolved and suspended solids. The streams discharged to the raw water pond under this option are the building effluent, boiler ash quench/seal water, air preheater wash water, and coal and ash pile run off. These wastewater streams are treated using cold lime softening prior to discharge to the soft water, or cooling tower feed pond. Treatment system components include chemical feed systems, clarifiers, and sludge dewatering equipment. Recycled streams that do not require treatment prior to being used as cooling tower make-up are discharged directly to the softwater pond. Cooling tower (CT) blowdown is discharged to the CT blowdown pond along with the boiler feed water regeneration wastes (neutralization sump effluent) and chemical cleaning wastes, which are too high in dissolved solids to use as cooling tower make-up.

An evaporator for treating CT blowdown pond effluent and a crystallizer to treat the waste brine stream from the evaporator are provided. A reverse osmosis unit (RO) has been included

ahead of the evaporator to reduce the volume of waste treated by this unit. Treated water from the crystallizer, evaporator and RO is directed to the condensate polisher for reuse in the boiler and to the soft water pond to serve as cooling tower make-up. A block flow diagram for this option is presented in Figure 4.6.

Components were sized based on maximum precipitation and average flows. Variation in the daily water balance at each station may result in some raw water make-up and waste water discharges.

Table 4.5 summarizes current treatment of wastewater effluent streams at fossil subcategory stations.

Table 4.5
Fossil Station Wastewater Streams and Current Treatment

Wastewater Stream	Treatment	Station
Ash Pile Runoff	Settling	Nanticoke TGS
Ash Transport Water	Settling and/or clarification and filtration	Atikokan, Thunder Bay, Lakeview & Lambton TGS
	Settling	Nanticoke TGS
Ash Quench/Boiler Seal Water	No treatment	Nanticoke, Lambton, Lakeview and Lennox TGS
Boiler Blowdown	No treatment	All stations
Building Effluent	No treatment	All stations
Coal Pile Runoff (1)	Settling pond	Lambton
	Lagoon/liming	Lakeview
	Co-treatment with ash transport water	Thunder Bay, Nanticoke
Maintenance/Cleaning Wastes	Mixed with ash transport water(in some plants) or natural evaporation or off-site disposal	All stations
Water treatment plant wastes	Acid and alkali regenerant streams mixed in the neutralization sump and discharged.	All stations
Neutralization sump effluent	Settling pond	Lennox
	Co-treated with ash transport water	Lakeview & Nanticoke
Oily water wastes	Oily water separator(s)	Atikokan, Lakeview, Lennox, Thunder Bay

(1): Except Atikokan TGS which has no coal pile run off treatment and oil fired Lennox TGS.

Table 4.6 summarizes changes to treatment of wastewater effluent streams at fossil subcategory stations under each BAT option.

Table 4.6
Changes to Effluent Streams Under BAT Options for Fossil Stations

BAT Option	Stream Abbreviation: BAT Treatment
I Best in Ontario	NS: to ash transport water treatment system (ATWTS) EC: boiler acid wash - collect in holding pond and treat with lime or caustic EC: air preheater - to ATWTS, boiler tubes fireside - to ATWTS BE: collection and treatment by oil/water separator CP: to ATWTS (partial recycle as dust suppressant on coal piles
IA Treatment of Boiler Ash Quench/Seal Water	Boiler Ash Quench/Seal Water: clarification and filtration
II Environment Canada Codes of Practice	BE: pretreatment by oil/water separator AT, NS, BE, CP, EC, OW: collection, equalization, physical/chemical treatment
III No Discharge of Proven Toxic Streams	AT, NS, CP, AT, EC: collection, equalization, physical/chemical treatment pH adjustment BE: treatment by oil/water separator to above phys./chem. treatment BB: steam recovery, reuse of water phase
III Minimum Discharge (no flue gas desulphurization)	AT, CP, EC, EO: partial reuse NS: 100% reuse BB: 100% reuse CW: 100% reuse (only auxiliary equipment heat load cooling tower)
V Best in Canada - Zero Discharge	AT, BE, BB, CP, EC, EO, OW, SW, NS, CW, CCW: 100% reuse

Notes:
AT = ash transport water treatment system (ATWTS)
NS = neutralization sump effluent
BE = building effluent
BB = boiler blowdown effluent
CP = coal pile effluent
EC = equipment cleaning (ie. boiler layup) effluent
EO = emergency overflow
SW = storm water
CCW = condenser cooling water
OW = oil water separator effluent
CW = Cooling water (service water)

Table 4.7 summarizes the identified incremental technologies by Bat Option for the Fossil Subcategory Stations.

Table 4.7
Identified Incremental Technologies by BAT Option for Fossil Plants

Technologies	BAT Option					
	IA	I	II	III	IV	V
Oil/water separator (a)		X	X	X	X	X
Clay lined ash pile (b)		X				
Pond/clarifier(with coagulant) (c)		X	X	X	X	X
Flash tank/equalization basin			X	X	X	X
Neutralization system			X	X	X	X
Double-lined settling pond (coal/ash pile run-off)			X	X	X	
Heat exchanger (boiler blowdown)				X		
Vacuum filter			X	X	X	
Double-lined acid waste pond (d)		X	X	X	X	
Cooling tower					X	X
Brine evaporator & crystallizer					X	X
Soft water pond					X	X
Polishing filter (e)		X	X	X	X	
Double lined raw water pond						X
Reverse osmosis unit					X	X
Clarification/Filtration (f)	X					
Condensate Polisher					X	X
Media Filter						X
Lab drain collection tank			X	X	X	X

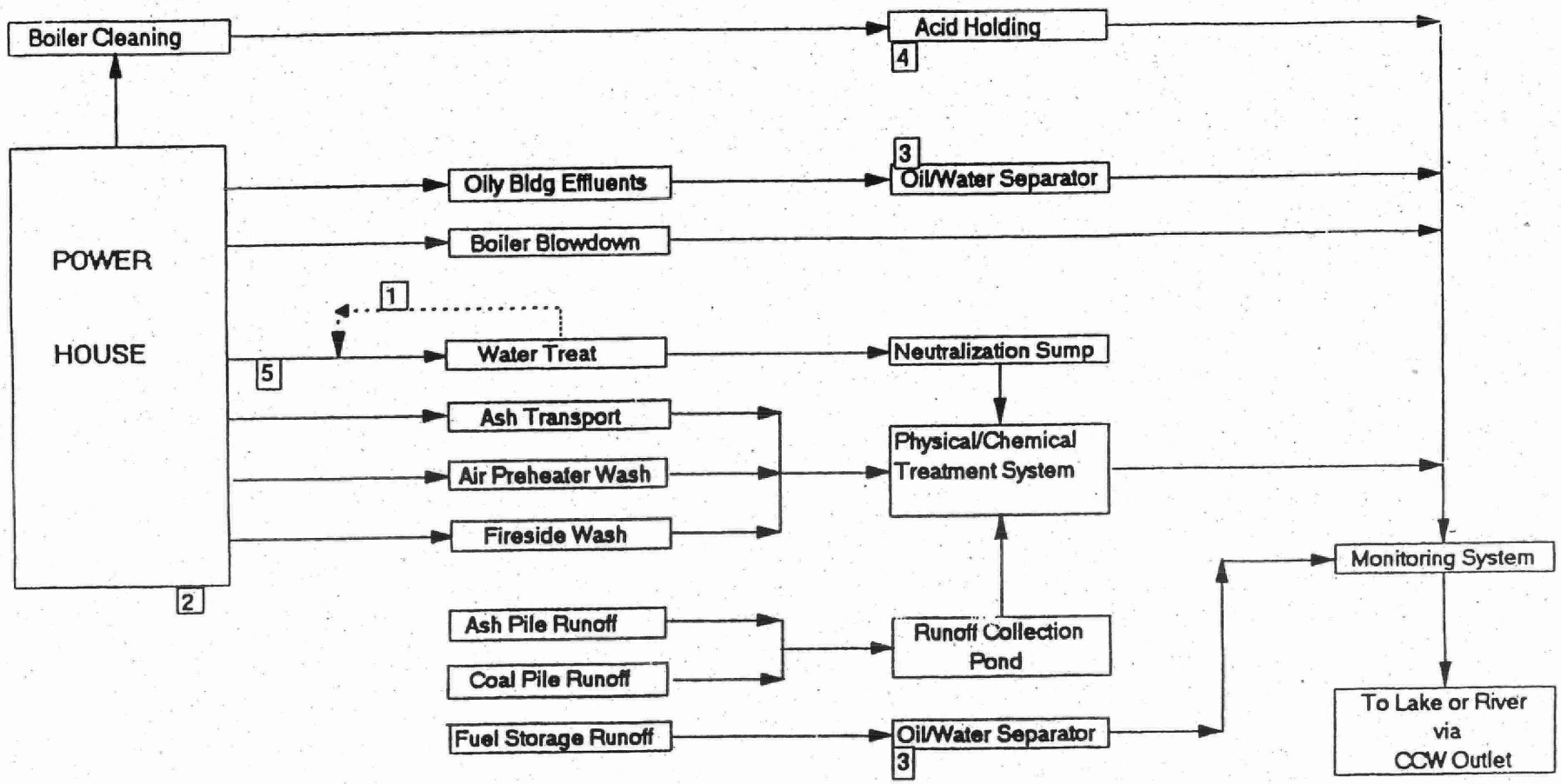
Notes:

BAT Options:

- Option IA = Quench/Seal Effluent Treatment Option
- Option I = Best-In-Ontario Composite Option
- Option II = Environment Canada Codes of Practice Option
- Option III = Non-Toxic Effluent Option
- Option IV = Minimum Discharge Option (no flue gas desulphurization)
- Option V = Best-In-Canada Option (Zero discharge)

Note(a): Except at Lennox & Thunder Bay TGS
Note(b): Except at Atikokan & Lennox TGS
Note(c): Except at Lambton TGS (options IA,I & II) and Thunder Bay TGS for Options IA, II & III.
Note(d): Except at Lambton and Thunder Bay TGS (options IA, I, II, III, & IV)
Note(e): Except at Lambton TGS for Options IA,I & II
Note(f): Except at Atikokan, Thunder Bay & Lennox TGS

Refer to the report "Evaluation of Best Available Technologies for the Electric Power Generation Sector Subcategory A Fossil/Hydraulic[2]", June 1993 for more detailed BAT treatment configurations



1 Filter Backwash returned to clarifier

2 Sanitary wastes handled separately

3 Waste oil applied to coal pile

4 Treat with lime or caustic

5 Raw Water

Figure 4.1[2]
Fossil Stations
Best in Ontario Composite

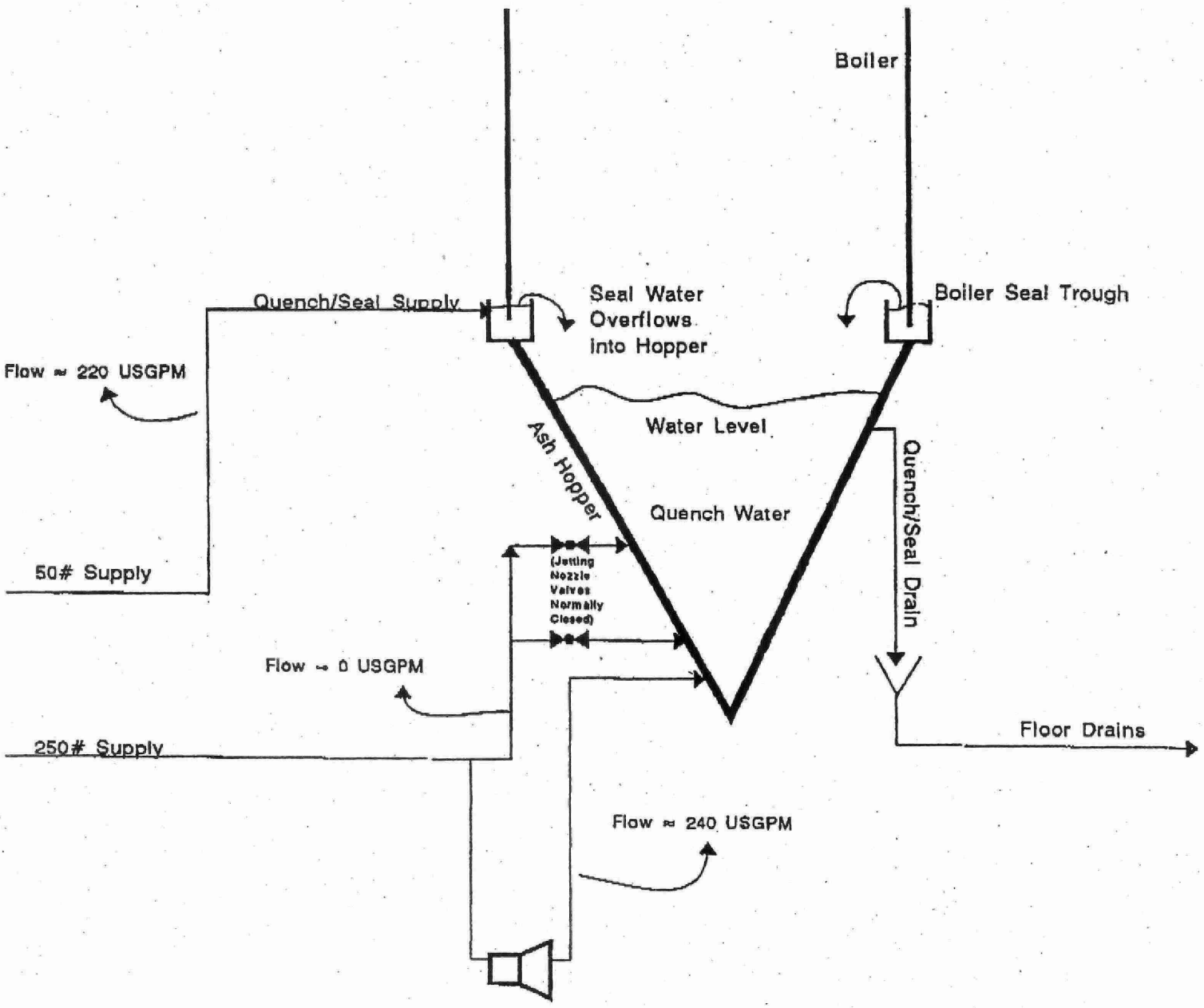
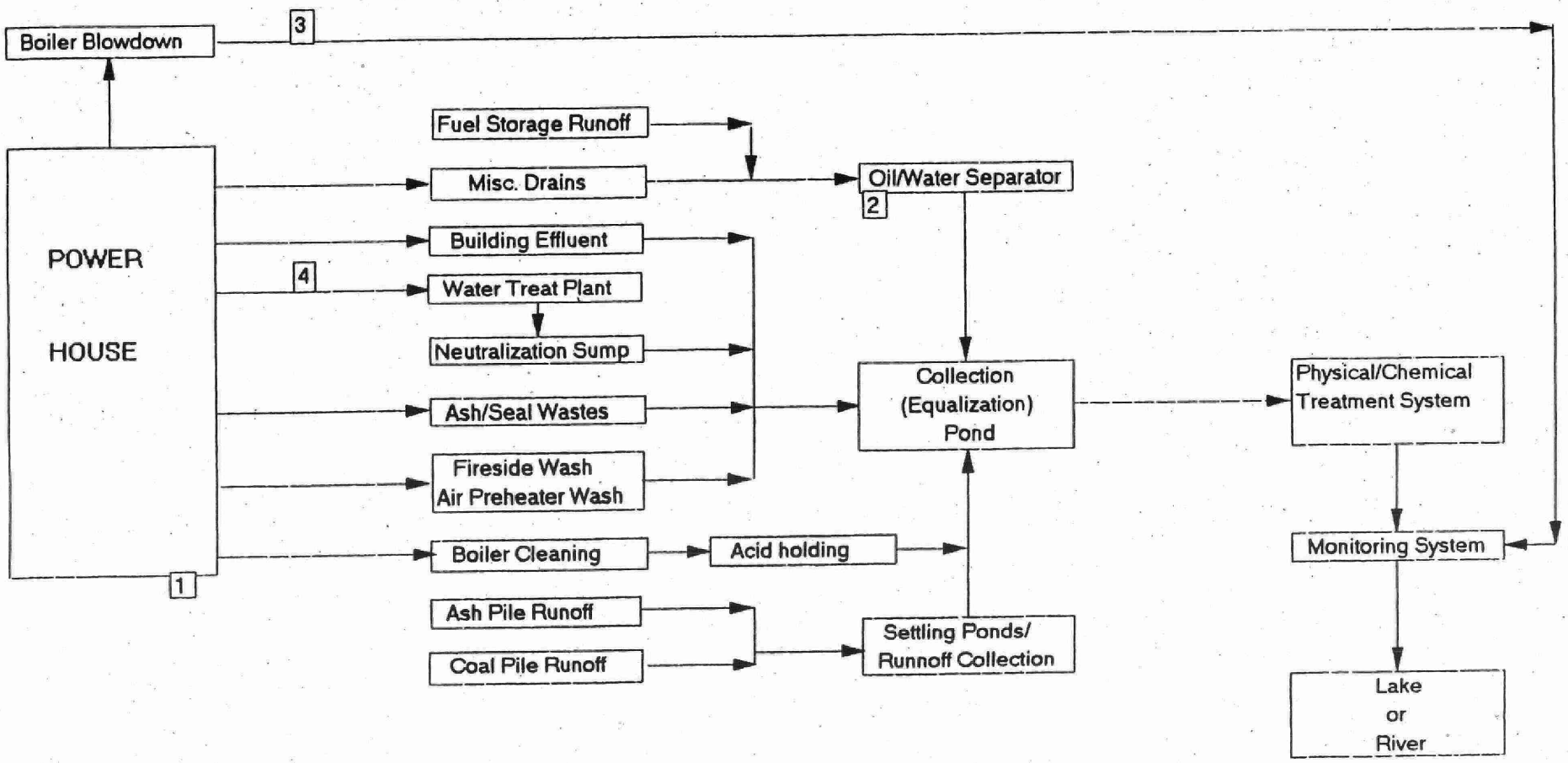


Figure 4.2[2]
Nanticoke TGS
Quench/Seal Water System Schematic



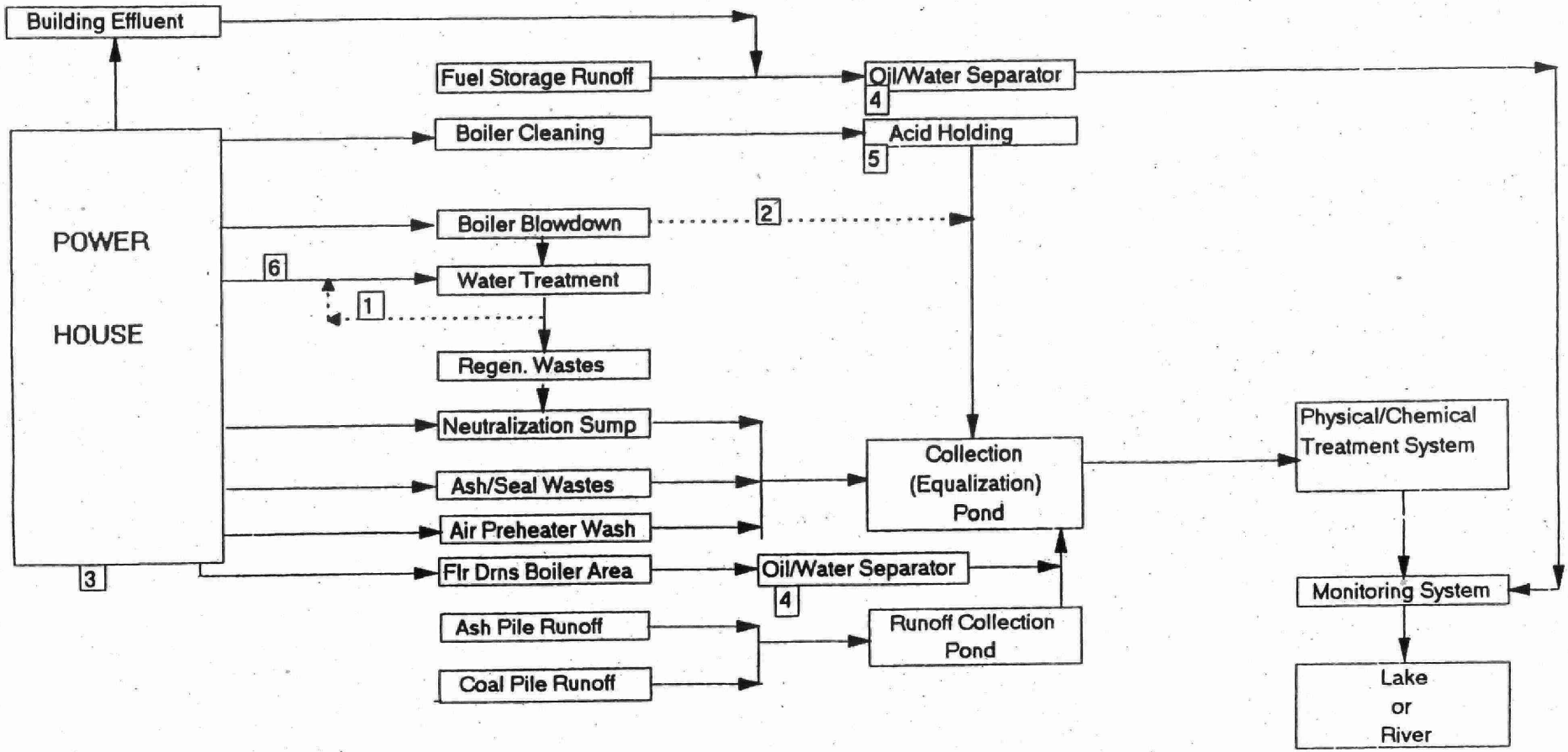
1 Sanitary wastes handled separately

2 Waste oil applied to coal pile or disposed offsite

3 Directed to Collection Pond during start up

4 Raw Water

Figure 4.3[2]
Fossil Stations
Environment Canada Design Codes of Practice Effluent Quality



1 Filter Backwash returned to clarifier

2 Intermittant- for maintenance and start-up

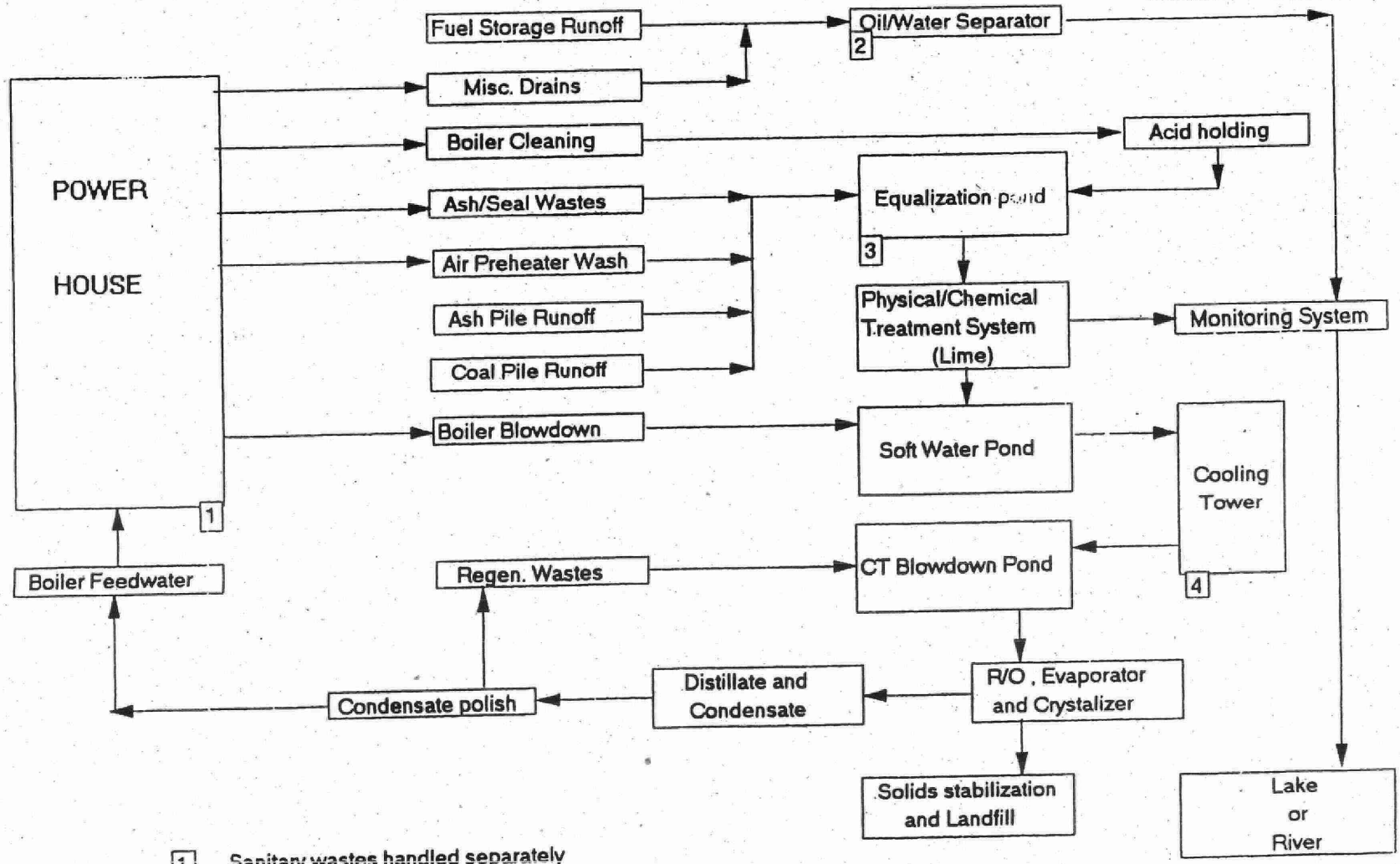
3 Sanitary wastes handled separately

4 Waste oil disposed off site

5 Treat with lime or caustic

6 Raw Water

Figure 4.4[2]
Fossil Stations
No Discharge of Proven Toxic Streams



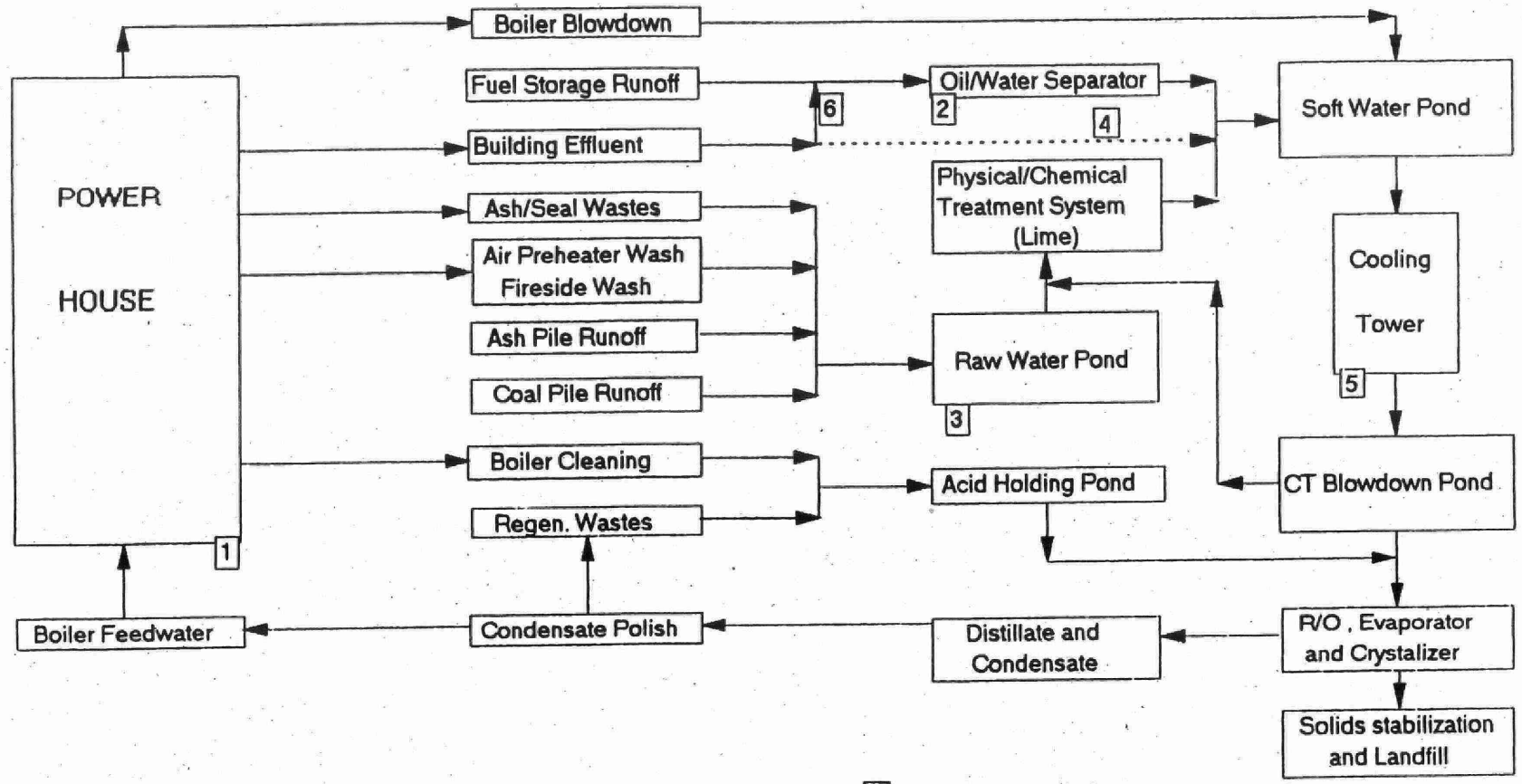
1 Sanitary wastes handled separately

2 Waste oil to off-site disposal

3 Fresh water makeup as required

4 Aux. heat loads only

Figure 4.5[2]
Fossil Stations
Minimum Discharge without Cooling Tower for Main Condenser Cooling



1 Sanitary wastes handled separately

2 Waste oil to off-site disposal

3 Fresh water makeup as required

4 Clean area drains

5 All cooling loads

6 Oily Sump Discharges

Figure 4.6[2]
Fossil Stations
Best in Canada

4.3 BAT Options for Hydraulic Stations

The BAT consultant identified no BAT options for the hydraulic subcategory and recommended the implementation of Best Management Practices at hydraulic stations[2].

Effluent from hydraulic generating stations consists primarily of transformer cooling water, drainage from floors, trenches and inspection tunnels as well as water drained from turbines prior to maintenance.

No significant levels of contamination were detected in the effluent monitored when compared with intake water quality and effluent quality recommended under the Environment Canada Codes of Practice[5]. Furthermore, no true "process waste water streams" are discharged at the hydraulic stations. Refer to Appendix B, Table 39 for listing of data collected.

4.4 BAT Options for Nuclear Stations

The four BAT options developed for the nuclear station subcategory stations are described briefly below. A more detailed description and discussion can be found in the report on the Evaluation of Best Available Technologies for the EPGS Subcategory B : Nuclear/Other[3].

Wastewater reuse strategies are incorporated into the BAT options for nuclear stations wherever possible, as a best management practice, and also because the concentrations of contaminants in the nuclear subcategory effluents are relatively low compared to conventional treatability levels; therefore, higher increments in loading reductions are achieved most cost affectively through wastewater reuse measures. For this reason, the primary difference in the three higher(II, III & IV) BAT options is in the amount of waste stream recycle employed. Waste stream recycle is used extensively under the minimum discharge option and to a lesser extent from the Partial Reduction of Toxic Streams Option to the Environment Canada Codes of Practice Option.

Each stream at nuclear stations, as monitored during the MISA monitoring period, is described in section 3 of this report.

4.4.1 Nuclear Stations Option I: Best in Ontario

A block diagram of the Best in Ontario option is presented in Figure 4.7. The handling of each process effluent under this option is described below.

Neutralization Sump Effluent

The AWT/M&E BAT study identified Bruce-B as having components of a Best in Ontario configuration for neutralization sump effluent because of existing effluent pH adjustment (NaOH and/or H_2SO_4 are used). The other three nuclear stations do not presently control pH of neutralization sump effluent; therefore, pH control was costed for these stations under the Best in Ontario option.

Building Effluent (non- radioactive drainage)

Treatment of building effluent is not practised at any of the nuclear stations. These effluent are directly discharged to the cooling water outfall.

Oil/Water (O/W) Separators

Darlington was selected as the "Best in Ontario" configuration for handling of non-active drainage potentially contaminated with oil. Based on O/W separator treatment installed at Darlington for drainage from the lube oil storage area, O/W separators were costed for the lube oil storage areas at Bruce-A, Bruce-B and Pickering.

Radioactive Liquid Waste Management System (RLWMS)

The radioactive liquid waste management system is similar at all four nuclear stations; therefore, all stations were identified as having "Best in Ontario" treatment available.

Radioactive Area Floor Drains

At all stations the radioactive area floor drains discharge to the radioactive liquid waste management system via collection sumps. Best in Ontario practice for handling radioactive area floor drains was identified at Bruce-B because of an oil water separator/activated carbon filtration system upstream of the radioactive liquid waste management system. An oil separation, carbon filtration treatment system, which was not noted in the BAT report, also exists at Bruce-A.

Based on the treatment available at Bruce-A and Bruce-B oily water separators were prescribed for radioactive area oily drains at Darlington and Pickering.

4.4.2 Nuclear Stations Option II: Environment Canada Codes of Practice Effluent Quality

Measures recommended under the BAT option required to meet the effluent criteria specified under the Environment Canada Codes of Practice are described below for each process stream. A block flow diagram of this option is presented in Figure 4-8.

Neutralization Sump Effluent

Under the Environment Canada Codes of Practice Option, neutralization sump effluent is treated by lime softening and filtration.

Radioactive Liquid Waste Management System (RLWMS) Effluent

Treatment by ion exchange/filtration is available at all nuclear stations for processing RLWMS wastewater high in radioactivity. Under the Environment Canada Codes of Practice option, continuous filtration and ion exchange treatment is prescribed for RLWMS wastewater. pH adjustment is also prescribed.

Oily Water Separator Effluent

Under this option, oily water separator streams at Darlington and Pickering are combined with neutralization sump effluent in an equalization pond for treatment by lime softening and filtration.

Equipment Cleaning Effluent

Boiler Layup: Co-treatment of boiler layup effluent with neutralization sump effluent in physical/chemical treatment system was recommended under this option. The monitoring data for boiler layup effluent at Pickering showed higher concentrations for all parameters; therefore, storage or off-site treatment was recommended for this stream.

Building Effluent (nonactive, not oily)

Treatment for building effluent is not prescribed under the Environment Canada Codes of Practice Option.

Boiler Blowdown

Under this option steam from boiler blowdown is recovered via deaerator. The water phase is discharged to the condenser cooling water channel (CCW) except during start-up when it is diverted to a collection pond.

4.4.3 Nuclear Stations Option III: Partial Reduction of Toxic Streams

Streams found to be toxic during the MISA monitoring period include boiler blowdown, neutralization sump effluent and radioactive liquid waste management system (RLWMS) effluent. Technology prescribed under this option minimizes the discharge of these streams. A block diagram of this option is presented in Figure 4.9.

Neutralization Sump Effluent

Under the Partial Reduction in Toxic Streams Option, discharge of ion exchange regeneration wastes is eliminated by evaporation in a vapour compression evaporation train. Distillate from the evaporator is recycled to the demineralizer system and evaporator bottoms are solidified in a crystallizer for landfill disposal.

Radioactive Liquid Waste Management System

Effluents from the RLWM systems cannot be recycled because of concerns about possible increases in radiation doses to plant personnel - due to tritium concentration build-up. Treatment of this stream is identical to the system prescribed under the "Environment Canada Codes of Practice" option.

Building Effluent

Building effluents are recycled to the extent permitted by the daily water balance of each station.

Boiler Blowdown Effluent

Steam from boiler blowdown is recovered in a flash tank and the water phase is directed to the lime softening treatment train for reuse.

4.4.4 Nuclear Stations Option IV - Minimum Discharge

Technologies prescribed under this option eliminate the discharge of effluent to the maximum extent possible through treatment and recycle of waste streams.

Use of a cooling tower allows recycle of cooling water. Steam is recovered from flashed boiler blowdown and the remaining condensate and cooling tower blowdown are treated by reverse osmosis (RO). Reject from reverse osmosis is evaporated in a vapour compression evaporator. Distillate from the evaporator and permeate from the RO unit are "polished" and recycled to the steam generator. Evaporator bottoms are crystallized and disposed to landfill. Building effluents are recycled as cooling tower make-up. Although control of storm water does not form part of any of the BAT options, storm water may also be used for cooling tower makeup in the minimum discharge option.

Effluent from the RLWM system are not recycled because of concerns about radiation doses to plant personnel. Treatment of this stream is identical to the system prescribed under the "Environment Canada Codes of Practice" option. A block flow diagram for this option is presented in Figure 4-10.

Table 4.8 summarizes current treatment of wastewater effluent streams at nuclear stations

Table 4.8
Nuclear Station Wastewater Streams and Current Treatments

Process Stream	Treatment	Station
Boiler Blowdown	No treatment	All stations
Building Effluent (not active, not oily)	No treatment	All stations
Non-radioactive potentially oily drains	Oil/water separator + granular activated carbon	Darlington
Radioactive potentially oily drains	Oil/water separator + granular activated carbon (upstream of RLWMS)	Bruce-A, Bruce-B
Lube oil storage area	Oil/water separator	Darlington, Pickering
Ion exchange regeneration wastes	self neutralization in the neutralization sump	All stations
Neutralization sump effluent	pH adjustment	Bruce-B
Radioactive liquid waste management system (RLWMS) effluent	Filtration + ion exchange (available if required)	All stations

Table 4.9 summarizes changes to treatment of wastewater effluent streams at nuclear subcategory stations under each BAT option.

Table 4.9
Changes to Effluent Streams Under BAT Options for Nuclear Stations

BAT Option	Stream Abbreviation: BAT Treatment
I Best in Ontario	NS: mixing, pH control
II Environment Canada Codes of Practice	NS: lime precipitation, filtration RL: filtration/ion exchange of low radioactive level waste stream BB: steam recovery via deaerator OW: to lime softening treatment train EC: to lime softening treatment train or off-site disposal
III Partial Reduction in Toxic Streams	NS: no discharge - evaporation, crystallization, landfill RL: same as BAT option II BB: steam recovery, recycle of water phase ** BE: partial recycle EC: recycle or off-site disposal
IV Minimum Discharge	NS: 100 % recycle RL: same as BAT option II BE: 100% recycle BB: steam recovery, 100% recycle of water phase ** EC: 100% recycle or off-site disposal OW: 100% recycle CCW: 100% recycle
Notes: NS = neutralization sump effluent RL = radioactive liquid waste management system effluent BE = building effluent BB = boiler blowdown effluent EC = equipment cleaning effluent CCW = condenser cooling water OW = oil water separator effluent ** = provided tritium build-up not hazardous to operations personnel	

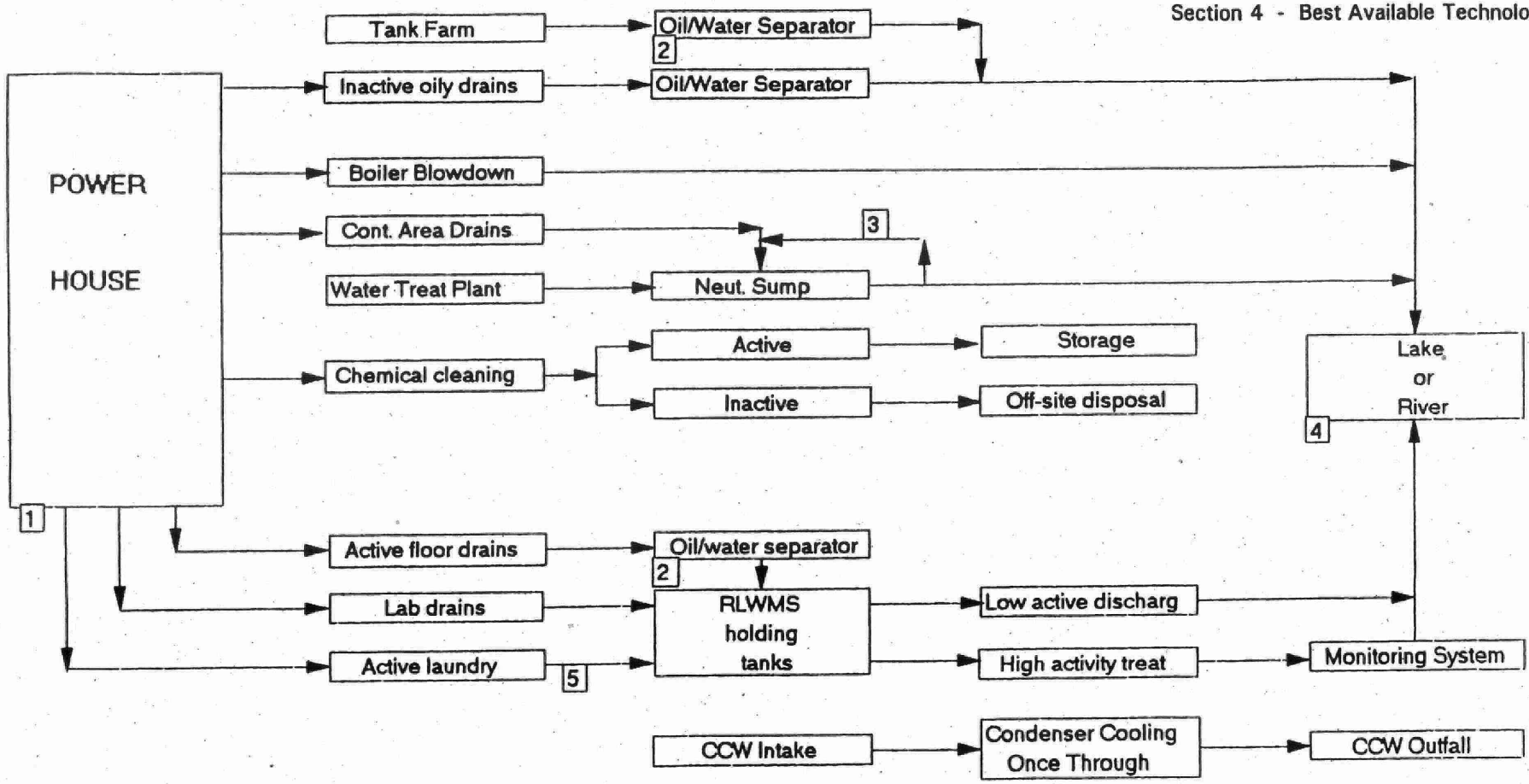
Table 4.10 summarizes the identified incremental technologies by BAT Option for nuclear stations:

Table 4.10
Identified Incremental Treatment Technologies by BAT Option for Nuclear Stations

Technology	Option			
	I	II	III	IV
Oily water separator(s)	X	X	X	X
Granular activated carbon	X			
Neutralization	X	X	X	X
Boiler blowdown flash tanks		X	X	X
Double-lined equalization pond		X		
Clarifier/thickener (with lime & coagulant)		X	X	X
Vacuum filter		X	X	X
Effluent polishing (media) filter		X	X	
Active waste treatment system		X	X	X
Raw water pond			X	X
Soft water pond			X	X
Evaporator			X	X
Crystallizer			X	X
Cooling tower				X
Cooling water blowdown pond				X
Condensate polishers (demineralizers)				X
Reverse osmosis (with UF treatment)				X

BAT Options:
Option I = Best in Ontario
Option II = Environment Canada Codes of Practice
Option III = Partial Reduction of Toxic Streams
Option IV = Minimum Discharge

Note:
Refer to the report "Evaluation of Best Available Technologies for the Electric Power Generation Sector Subcategory B Nuclear/Other" for detailed BAT treatment configurations.



1 Sanitary wastes handled separately

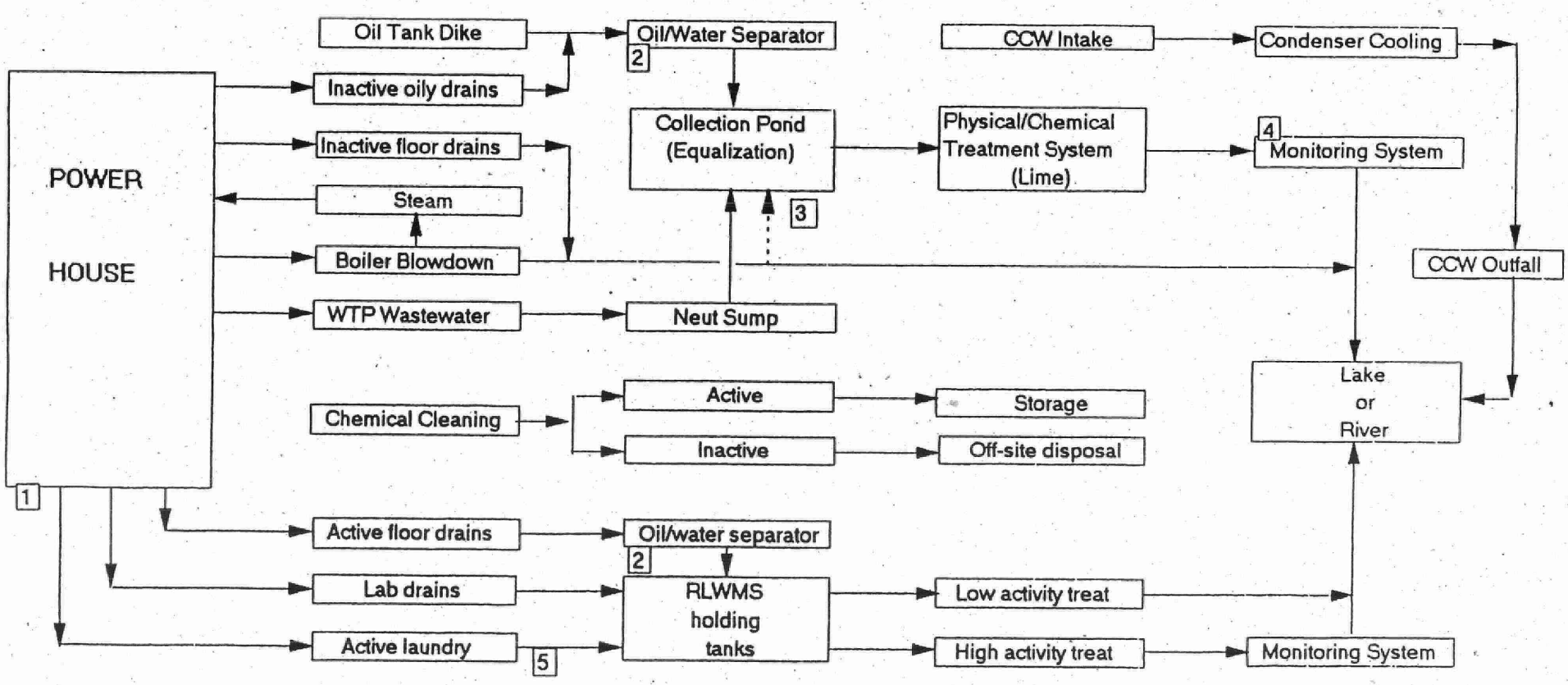
2 Waste oil to off-site disposal

3 Recycle if pH off-spec

4 Discharge via CCW

5 Active Laundry waste collected separately

Figure 4.7[3]
Nuclear Stations
Best in Ontario Composite



1 Sanitary wastes handled separately

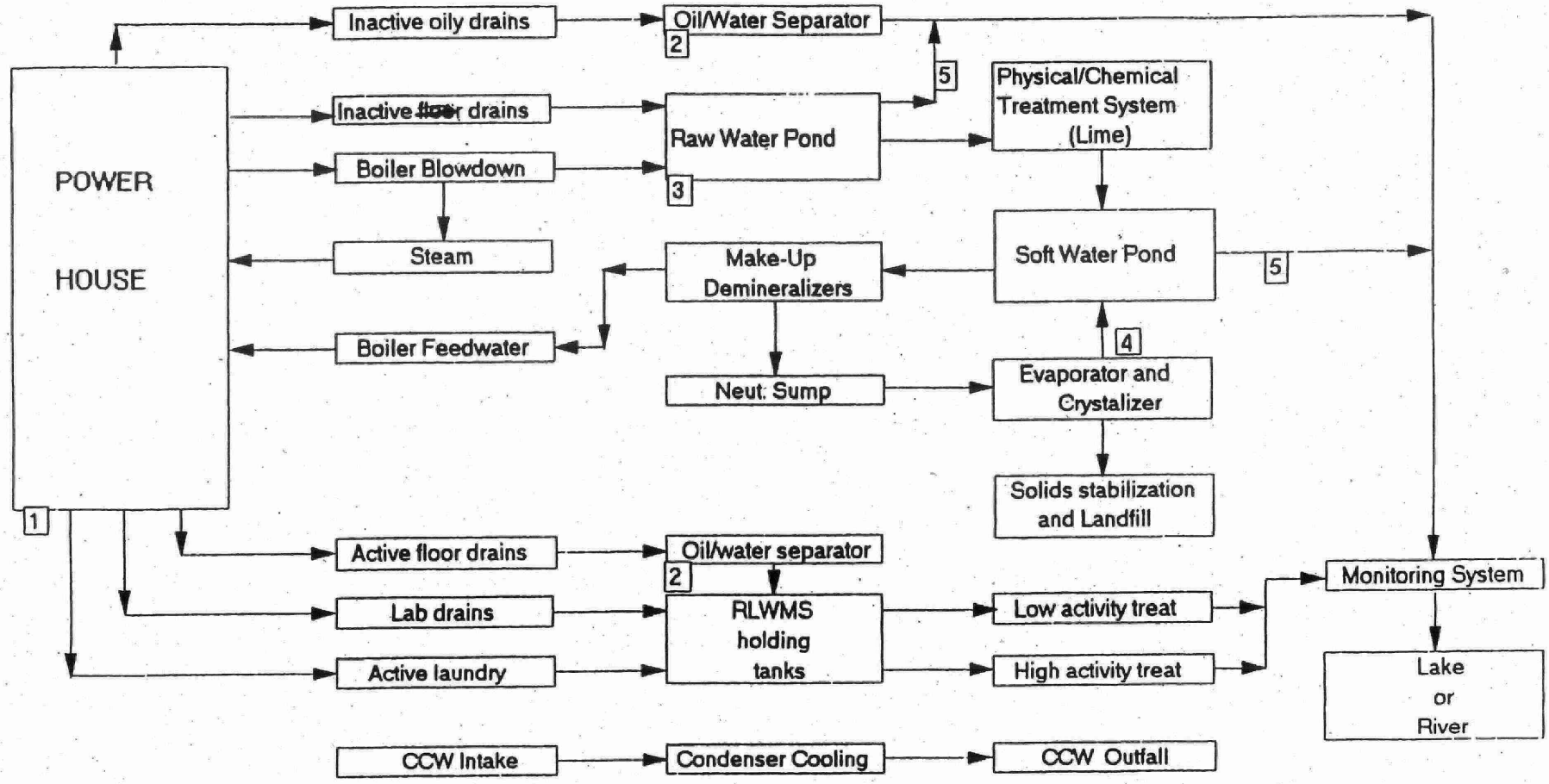
2 Waste oil to off-site disposal

3 During startup

4 Recycle, if required

5 Laundry Wastes collected separately

Figure 4.8[3]
Nuclear Stations
Environment Canada Codes of Practice Effluent Quality



1 Sanitary wastes handled separately

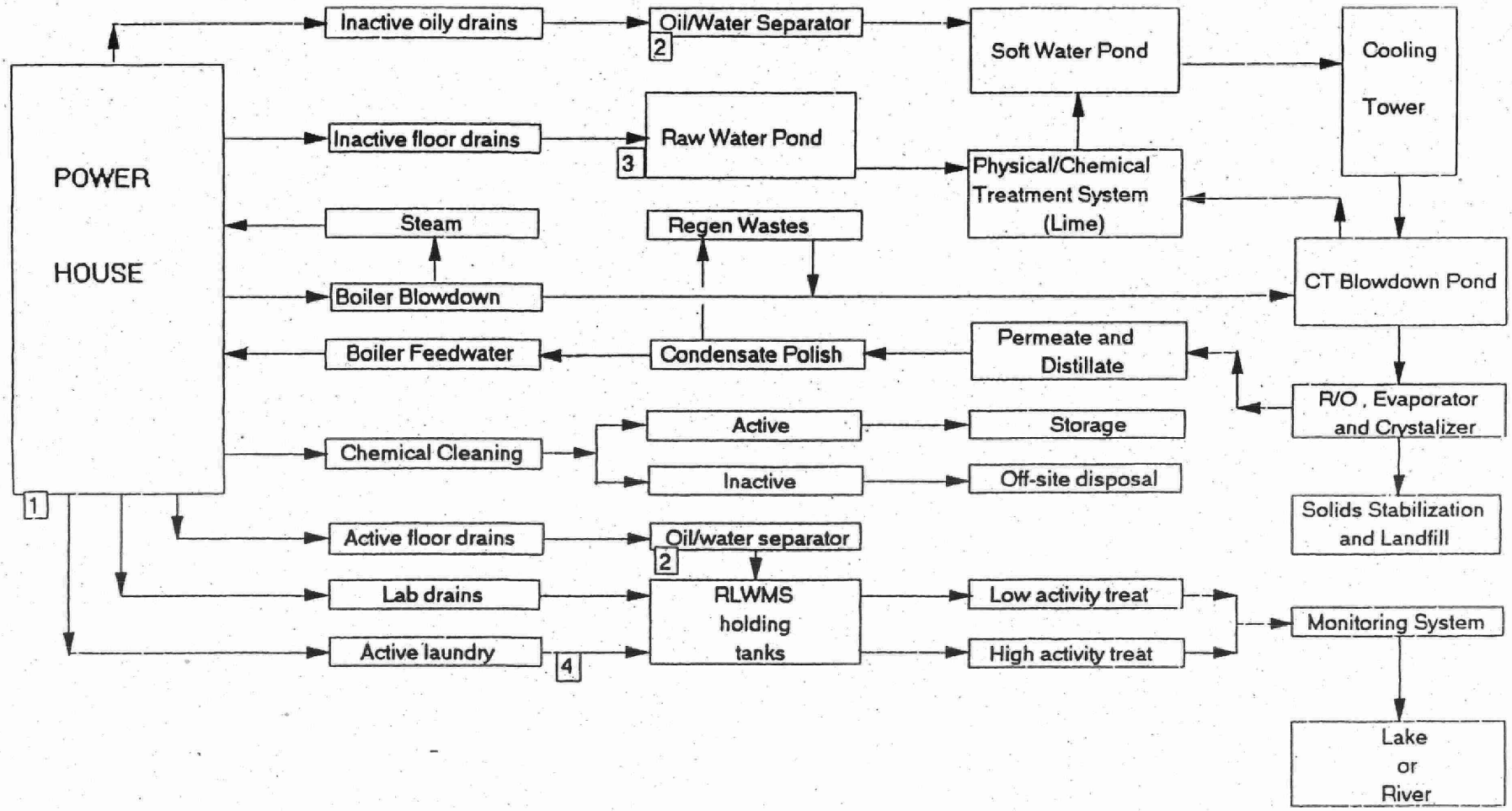
2 Waste oil to off-site disposal

3 Fresh water makeup as required

4 Distillate

5 Discharge only when needed

Figure 4.9[3]
Nuclear Stations
Partial Reduction of Toxic Process Streams



1 Sanitary wastes handled separately

2 Waste oil to off-site disposal

3 Fresh water makeup as required

4 Laundry Wastes collected separately

Figure 4.10[3]
Nuclear Stations
Minimum Discharge

BAT Options for Nuclear Associated Facilities

Two BAT options were developed for each of the nuclear associated facilities. Since each of these facilities are unique, the options are specific to each facility.

4.5 BAT Options for the Bruce Heavy Water Plant (BHWP)

4.5.1 BHWP Option I: Environment Canada Codes of Practice Effluent Quality

This option involves redirecting, for treatment or reuse, those streams which were found to have parameters exceeding the effluent quality recommended under the Environment Canada Codes of Practice.

Filter backwash from the water treatment plant which is currently discharged through control point 0100 - clarifier building effluent, is recycled to the clarifier to reduce TSS levels. Elevated levels of iron found in storm waters from the low pressure condensate area (control point 0700) and from the north flare area (control point 0800) are redirected to the surface water treatment facility. A block flow diagram for this option is presented in Figure 4.11

4.5.2 BHWP Option II: Minimum Discharge

Under the minimum discharge option all non-process flows are directed to the surface water treatment facility and used as input to the water treatment plant. Although stormwaters are not under consideration for effluent limits, they are recycled under this option as a best management practice. Process effluent cannot be recycled to the enrichment process because it is depleted in deuterium. A block flow diagram for this option is presented in Figure 4.12.

4.6 BAT Options for Bruce Nuclear Power Development (BNPD)

4.6.1 BNPD Option I: Environment Canada Codes of Practice

No parameters found in process effluent were above levels listed under the Environment Canada Codes of Practice recommendations for effluent quality; therefore, no additional

treatment was costed under this option.

4.6.2 BNPD Option II: Minimum Discharge

Under the minimum discharge option, effluent from the neutralization sump is treated by ultrafiltration, reverse osmosis, and evaporation. Distillate from the evaporators is recycled to the condensate makeup plant. Bottoms from the evaporator are sent to a crystallizer.

All other process streams are recycled to the condensate makeup water treatment plant. Steam transformer plant flash tank and blowdown tank effluent, floor drains and pump cooling water are recycled to the WTP via a cooling tower. Chemical wash pond effluent is sent directly to the WTP for reuse. A block flow diagram for this option is presented in Figure 4.13.

4.7 BAT Options for Darlington Construction Site

4.7.1 Darlington Construction Option I: Environment Canada Codes of Practice

The Environment Canada Codes of Practice BAT option for the Darlington construction site includes segregation of sanitary wastes and process wastes for separate treatment.

Process wastes are treated by conventional physical/chemical treatment consisting of lime precipitation, filtration and pH adjustment. Process streams directed to treatment include; boiler blowdown, neutralization sump effluent and equipment cleaning lagoon effluent. A block flow diagram for this option is presented in Figure 4.14.

4.7.2 Darlington Construction Option II: Minimum Discharge

Under the minimum discharge option, neutralization sump effluent, boiler blowdown effluent and equipment cleaning lagoon effluent streams are eliminated by evaporation and crystallization. Distillate from the evaporators is recycled to the water treatment plant. As a best management practice, compressor cooling water is eliminated by employing air cooled compressors . A block flow diagram for this option is presented in Figure 4.15.

Table 4.11 summarizes current treatment of wastewater effluent streams at nuclear associated facilities.

Table 4.11
Nuclear Associated Facility Wastewater Streams and Current Treatments

Process Stream	Treatment	Station
Boiler Blowdown	No treatment	BNPD, Darl.
Sewage treatment effluent	Biological treatment plant	BNPD, Darl.
Lube oil storage area	Oil/water separator	BNPD, Darl.
Water treatment plant wastes	self neutralization in the neutralization sump	BNPD, Darl.
High active waste	Filtration + ion exchange (at Bruce-A)	BNPD
Commissioning wastes (boiler layup)	Holding lagoon (settling)	Darl.
Surface drains + cleaning wastes	Surface water treatment facility	BHWP
Process effluent	aerated lagoons	BHWP

Notes:
BNPD = Bruce Nuclear Power Development Services
BHWP = Bruce Heavy Water Plant
Darl. = Darlington Construction

Each of these facilities are unique. Reader should refer to the report "Evaluation of BEST Available Technologies for the Electric Power Generation Sector Subcategory B Nuclear/Other" for detailed descriptions.

Table 4.12 summarizes changes to treatment of wastewater effluent streams at nuclear associated facilities under each BAT option.

Table 4.12
Changes to Effluent Streams Under BAT Options for Nuclear Associated Facilities

Facility	BAT Option	Stream Abbreviation: BAT Treatment
Bruce Heavy Water Plant	I	BE: recycle of filter backwash contained in BE SW: all SW to SWTF
	II	BE: 100% recycle SW: 100% recycle
Bruce Nuclear Power Development Services	I	No changes
	II	NS: no discharge - evaporation, crystallization PR: 100% recycle EC: 100% recycle
Darlington Construction Site	I	BB, NS, EC, WD: to physical chemical treatment
	II	BB, NS, EC, WD: no discharge - evaporation, crystallization OT: no discharge - change to air cooling

Notes:

NS	=	neutralization sump effluent
BE	=	building effluent
BB	=	boiler blowdown effluent
WD	=	waste disposal site effluent
EC	=	equipment cleaning effluent
PR	=	process effluent
SW	=	storm water effluent
SWTF	=	surface water treatment facility
OT	=	once through cooling water

Table 4.13 summarizes the identified incremental technologies by BAT Option for nuclear associated facilities.

Table 4.13
Identified Incremental Treatment Technologies by BAT Option for Nuclear Associated Facilities

Technology	Option	
	I	II
Cooling tower(a)		X
Ultrafiltration(a)		X
Reverse osmosis(a)		X
Evaporator(a)(b)		X
Crystallizer(a)(b)		X
Hold-up tank(b)	X	X
Clarifier/thickener (with lime/coagulant)(b)	X	
Vacuum filter(b)	X	
Media filter(b)	X	
Neutralization(b)	X	

BAT Options:
Option I = Environment Canada Codes of Practice
Option II = Minimum Discharge

Notes:
(a) specified for Bruce Services
(b) specified for Darlington construction
** Bruce Heavy Water Plant requires only piping additions to redirect flows through existing equipment

Each of these facilities are unique. Reader should refer to the report "Evaluation of BEST Available Technologies for the Electric Power Generation Sector Subcategory B Nuclear/Other" for detailed descriptions.

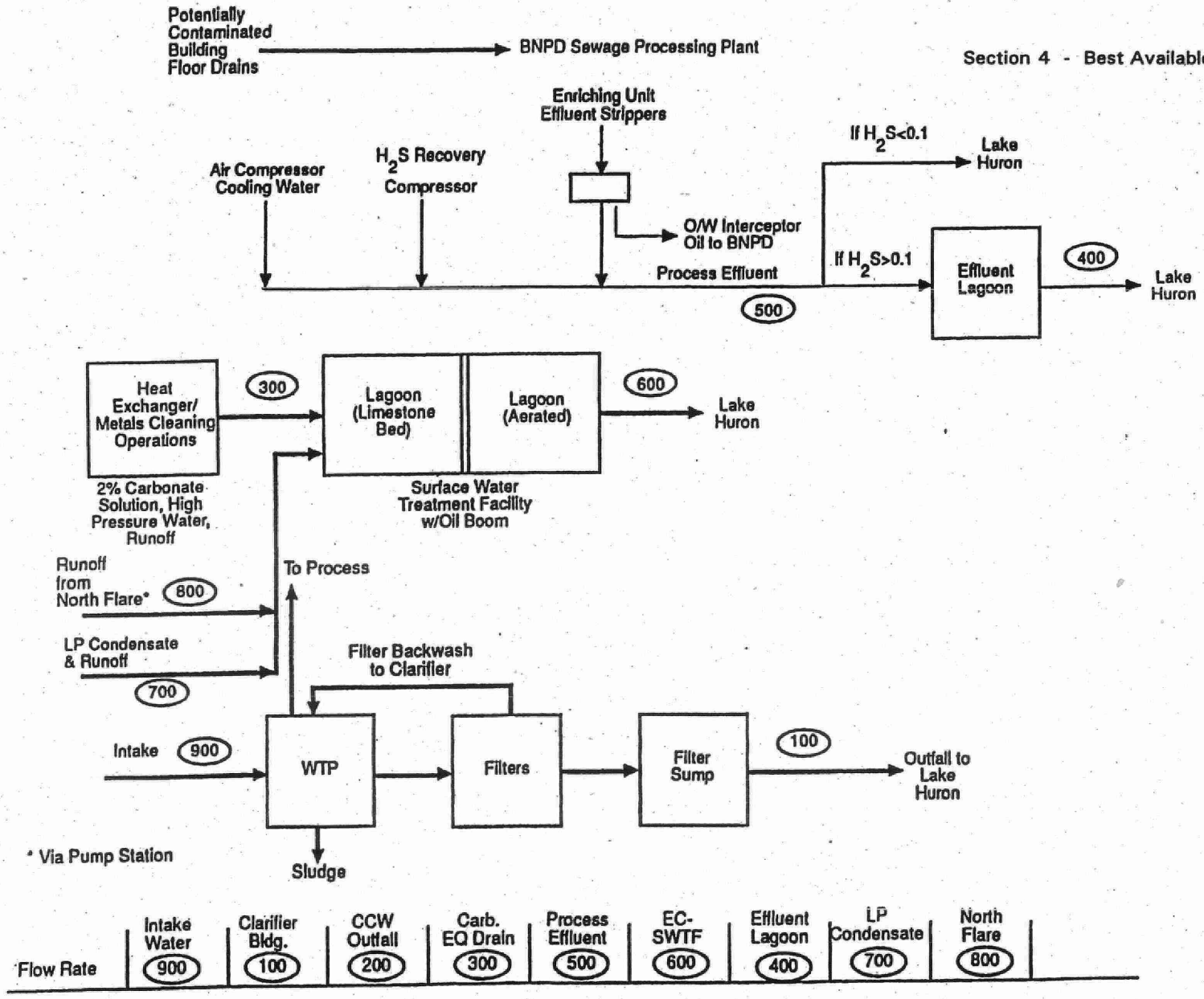


Figure 4.11[3]
Bruce Heavy Water Plant
Environment Canada Codes of Practice Effluent Quality

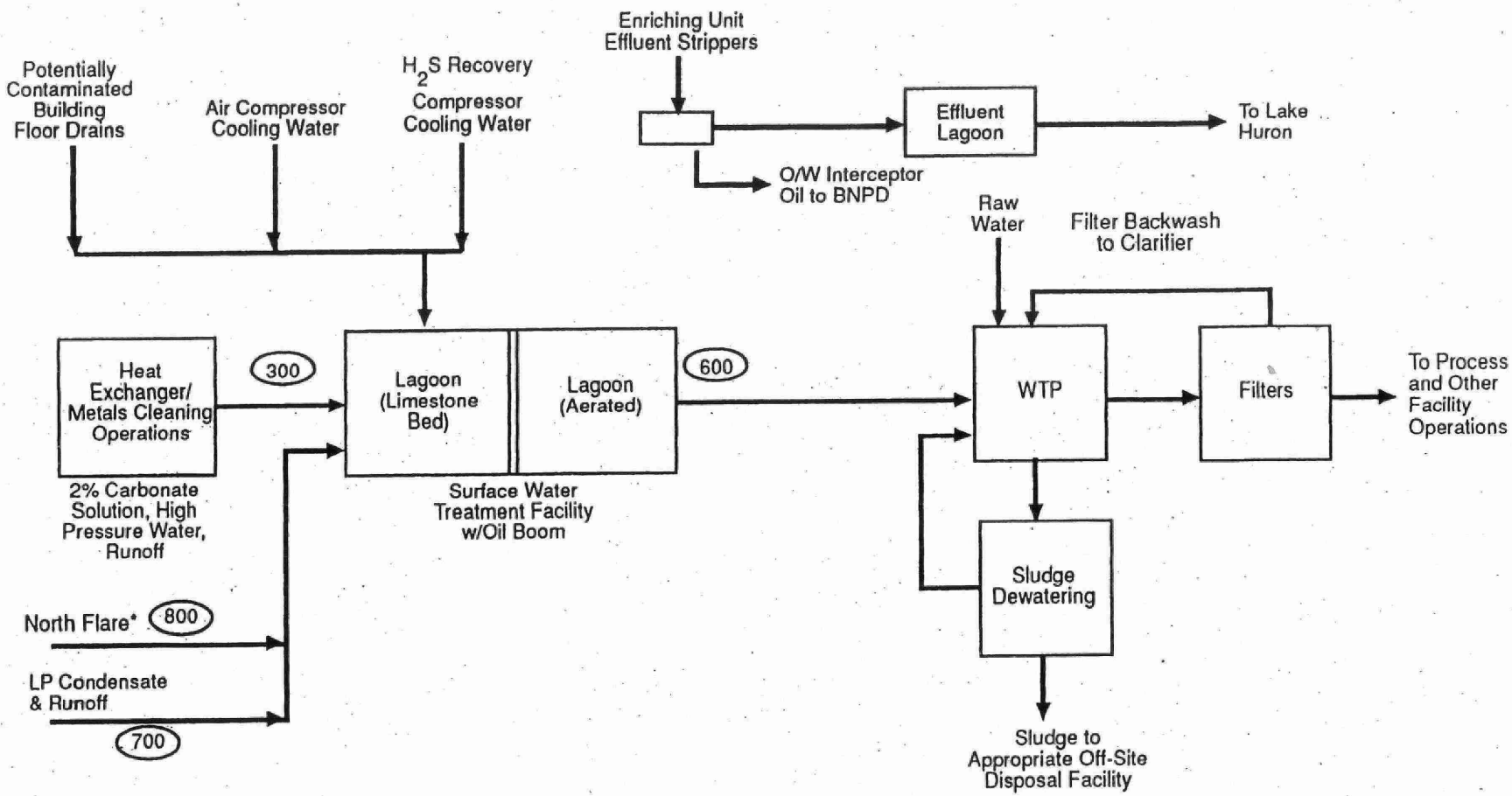
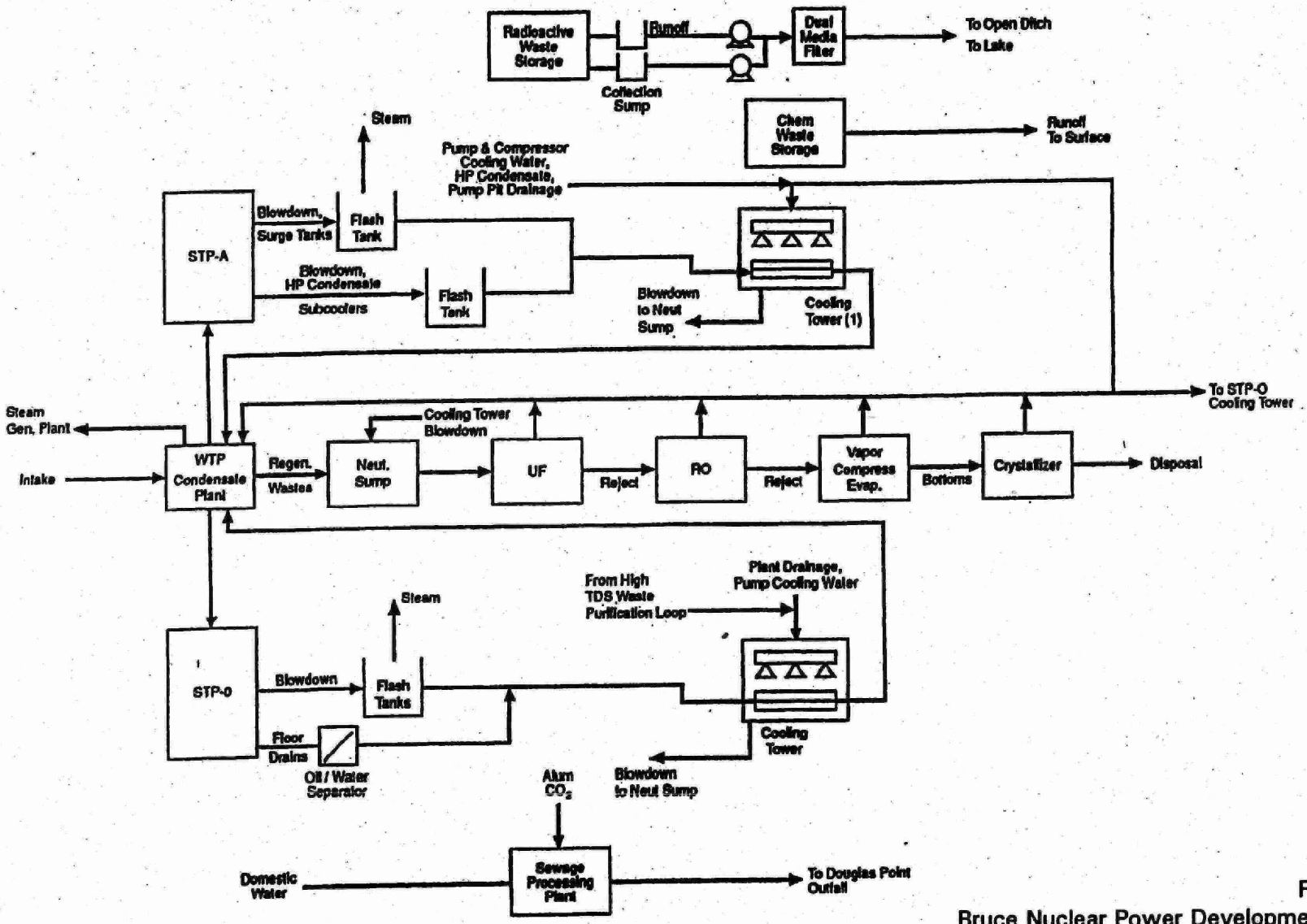
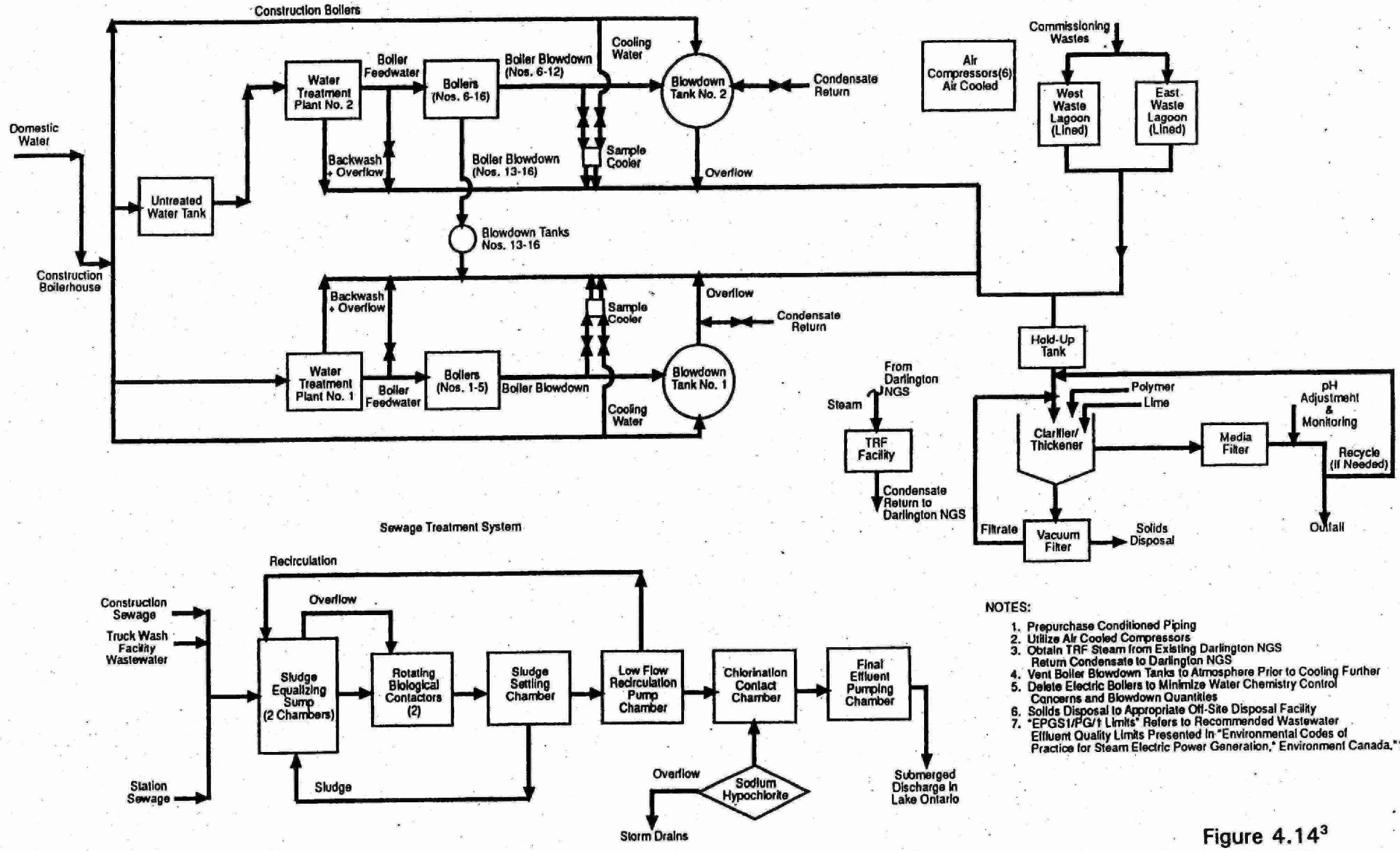


Figure 4.12[3]
Bruce Heavy Water Plant
Minimum Discharge



(1) Heat exchangers may be substituted for cooling towers, however no wet water loss will be achieved.
(2) After purification, High TDS wastes routed to either cooling towers as make-up or WTP depending on water balance needs.

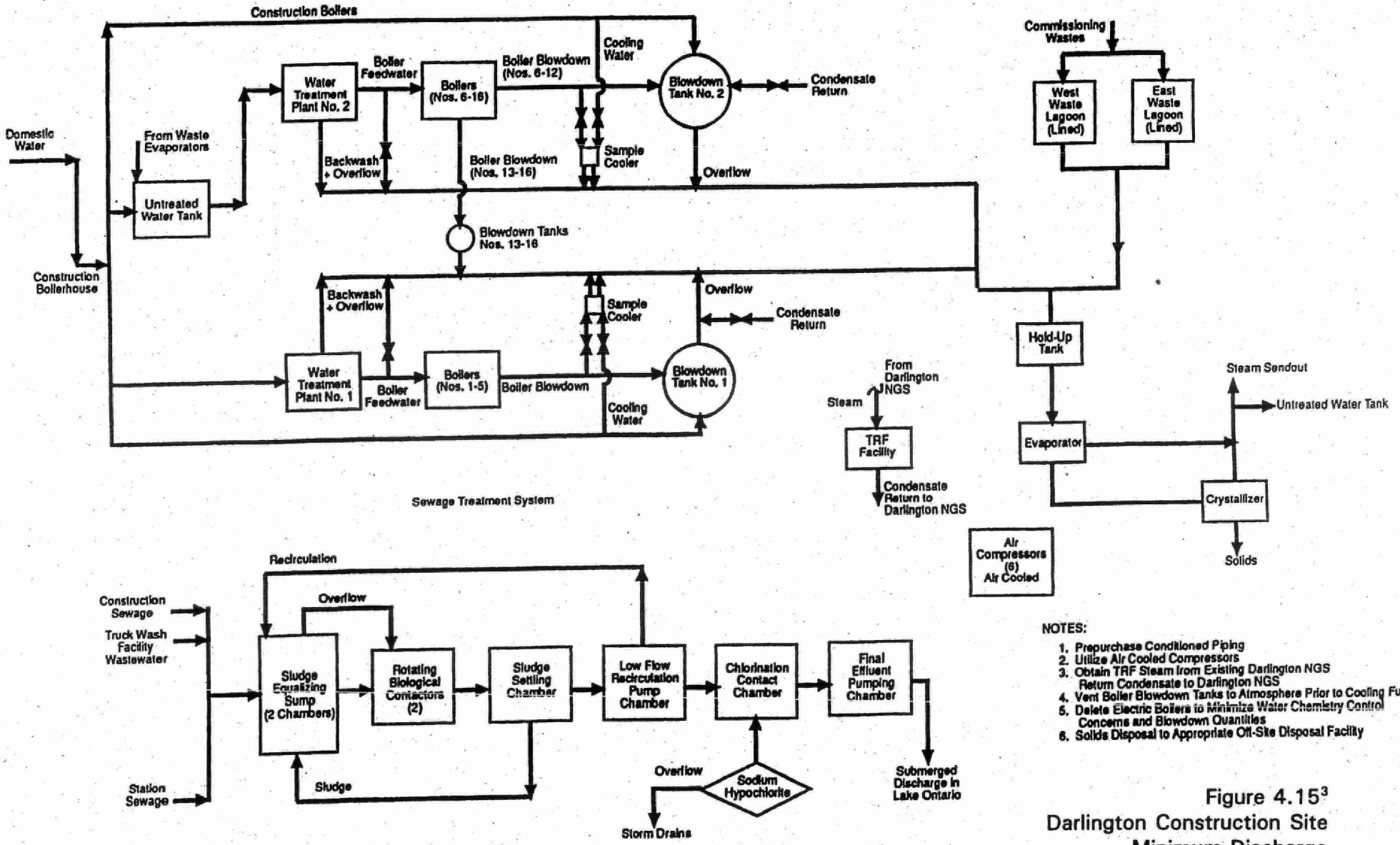
Figure 4.13[3]
Bruce Nuclear Power Development Services
Minimum Discharge



NOTES:

1. Prepurchase Conditioned Piping
2. Utilize Air Cooled Compressors
3. Obtain TRF Steam from Existing Darlington NGS Return Condensate to Darlington NGS
4. Vent Boiler Blowdown Tanks to Atmosphere Prior to Cooling Further
5. Delete Electric Boilers to Minimize Water Chemistry Control Concerns and Blowdown Quantities
6. Solids Disposal to Appropriate Off-Site Disposal Facility
7. "EPGS1/PG/1 Limits" Refers to Recommended Wastewater Effluent Quality Limits Presented In "Environmental Codes of Practice for Steam Electric Power Generation," Environment Canada, 1985

Figure 4.14[3]
Darlington Construction Site
Environment Canada Codes of Practice Effluent Quality



NOTES:

1. Prepurchase Conditioned Piping
2. Utilize Air Cooled Compressors
3. Obtain TRF Steam from Existing Darlington NGS Return Condensate to Darlington NGS
4. Vent Boiler Blowdown Tanks to Atmosphere Prior to Cooling Further
5. Delete Electric Boilers to Minimize Water Chemistry Control Concerns and Blowdown Quantities
6. Solids Disposal to Appropriate Off-Site Disposal Facility

Figure 4.15[3]
Darlington Construction Site
Minimum Discharge

4.8 Technology Option Costs and Attainable Loadings

In order to enable an economic assessment of each BAT option estimates of the loading reductions attainable through implementation of each option along with the cost of each option were necessary. These estimates are contained in tables 4.14, 4.15 and 4.16 for fossil stations, nuclear stations and nuclear associated facilities respectively.

4.8.1 Costs of the BAT Options

With the exception of the Ash Quench Water/Boiler Seal Water treatment option (IA) for the fossil stations subcategory, AWT/M&E estimated the capital and operating costs of installing the identified BAT technology options at each site in the fossil, nuclear stations and nuclear associated facility subcategories as part of the BAT study. The Ash Quench Water/Boiler Seal Water treatment option (IA) for the three fossil stations which do not currently treat ash quench and boiler seal waters (Nanticoke, Lakeview and Lambton) was cost estimated by Ontario Hydro in consultation with the Ministry EPGS BAT Subcommittee.

Cost estimates for implementing the various BAT options are based upon:

- identification of necessary equipment by comparing existing facilities with the BAT option requirements discussed earlier,
- sizing new equipment and systems according to MISA monitored flow rates. The capacities used for waste water treatment system unit operations are based upon mean daily flows. Equalization ponds/storage tanks are sized to accommodate maximum daily flows, and components such as cooling towers and condensate polishers which directly affect net facility output are sized for full capacity output,
- unit costs for capital equipment and annual O&M as provided by the Best Available Technology Study[1] conducted by Bechtel Inc. for Ontario Hydro,
- generating station derating penalties as calculated and provided by Ontario Hydro for the Best-In-Canada option for fossil stations and the minimum discharge option for nuclear stations,
- cost estimating factors for project implementation as provided by Ontario Hydro,

- additional piping costs identified by Ontario Hydro were added to the MOEE Consultant's cost estimates for all options,

- costs for implementing Option IA Ash Quench/Boiler Seal Water Treatment were added to all the other BAT Options.

Derating Cost Penalties

A cooling tower is included for main condenser cooling under the Best in Canada/Zero Discharge option for fossil stations and in the minimum discharge option for nuclear stations. When a cooling tower is installed for main condenser cooling, it affects unit generating efficiency by raising the condenser back-pressure and hence the turbine exhaust pressure; thus, the amount of work produced by each kilogram of main steam is reduced and results in a station derate. The reduced generating efficiency results in an increase in the cost of each kilowatt produced. Derating costs have been added to the respective capital costs in tables 4.14 and 4.15.

In addition to station derating, the fixed costs associated with station operation are distributed over a lower station generating capacity resulting in poorer economies of scale. These costs have not been assessed in this study.

4.8.2 Estimation of Loading Reductions

Reductions in loadings resulting from the installation of the BAT option IA: Treatment of Ash Quench/Boiler Seal Water at three fossil stations were estimated for only removal of total suspended solids, because data on the discharge of other parameters in these streams are unavailable. Loading reductions for the other fossil station BAT options were calculated for TSS, iron and copper. Reductions in loadings resulting from the installation of the BAT options at nuclear stations and nuclear associated facilities were calculated for four parameters; total suspended solids, iron, copper and zinc. These parameters were selected based on their prevalence in subcategory effluents. It is expected that control of these metals will also result in control of other metals. It was agreed by the BAT subcommittee that estimates of loading reduction for these "key" parameters would provide sufficient information for input to the economic assessment of the BAT options.

Loading reductions for the Treatment of Ash Quench and Boiler Seal Water Effluent Option at fossil stations are calculated by assuming installation of new or retrofitted ash

treatment systems to achieve a long term average effluent quality of 10 mg/L TSS.

Loading reductions for effluent treatment prescribed under BAT options for fossil stations, nuclear stations and nuclear associated facilities were estimated by assuming that a physical chemical treatment systems (ie. chemical precipitation/filtration) can be sized and operated to achieve the following average effluent concentrations;

- TSS 10 mg/L,
- Fe 200 ug/L,
- Cu 50 ug/L,
- Zn 50 ug/L.

An average decontamination factor (DC) of 100 (ie. 100 fold decrease in concentration) was assumed for a properly sized and operated ion exchange filtration system treating effluent from the radioactive liquid waste management system (RLWMS).

Further loading reductions calculated under any of the BAT options are the result of reductions in wastewater volumes discharged (ie. reuse).

4.8.3 Loading Reductions- Fossil Stations:

The contaminant loading reductions by implementing the various BAT Options at fossil stations were estimated as described below, and summarized in Table 4.14. The loadings attributable to building effluents have been excluded.

Base-line Loading: The base-line TSS loadings for Nanticoke, Lakeview and Lambton estimated by the MOEE consultant AWT/M&E were revised upwards to include the estimated TSS loadings contributed by the Ash Quench and Boiler Seal Water Effluent at these three facilities.

Treatment of Ash Quench and Boiler Seal water effluent Option IA: Reductions in TSS loadings resulting from implementation of this option were estimated assuming an untreated average TSS concentration of 40 mg/L in quench/seal water could be reduced to 10 mg/L by directing these streams to a clarification/filtration treatment system[7]. Data for metal concentrations in quench/seal water are not available.

Best-In-Ontario Option I: The loading reductions expected through implementing this option were based on the loadings

calculated for this case by the AWT/M&E with some adjustments for the following reasons. Table 4.14 reflects the loadings after these adjustments.

- Base-line loadings for Atikokan were over-estimated by the consultant due to incorrect assumptions on loading data calculations. Atikokan experienced 31 emergency over-flows at the Ash Transport Water Treatment System of varying volumes and the consultant used the maximum volume for their loading estimates rather than the actual volumes discharged[8].

- Lennox loadings were over-estimated due to the inclusion of transformer cooling water loadings by the consultant[9].

- Annual emergency overflow loadings at Lakeview were over-estimated by the consultant and have been corrected in Table 4-14[8].

Environment Canada Codes of Practice Option II: Loading reductions are primarily attributable to TSS reductions at Lambton and Nanticoke and Iron reduction at Lambton.

Non Toxic Discharge of Proven Toxic Streams Option III: The loading reductions in this option are derived from the elimination of toxic streams by their total reuse.

Minimum Discharge Option IV: The total reuse of all process streams defined the loading reduction for this option.

Best in Canada Zero Discharge Option: Since all discharges are recycled/reused, the base-line loading defines the loading reduction attainable.

4.8.4 Loading Reductions Nuclear Stations

Table 4.15 provides estimated loadings which are expected after implementation of each of the nuclear station BAT options. As a result of high loadings reported for building effluent and equipment cleaning effluent at Pickering as discussed in the AWT/M&E BAT report[3], data for these streams were reviewed. Flow reporting errors were also discovered for both of these streams. The revised loadings are based on corrected monthly flow data and calculated by summing up the average revised monthly flow for each stream times the measured parameter concentration for each

stream[10]. The BAT consultant made an error in reporting TSS residual loadings (from RLWMS) on implementing BAT Options II, III & IV. These loading estimates have been revised from those contained in the BAT report[3].

Nuclear Stations: Best In Ontario

Zero loading reduction is expected through application of the Best in Ontario option as developed by the BAT consultant. pH control is the primary technology prescribed under this option. Oily water separators for lube oil storage areas are recommended as a best management practice.

Nuclear Stations: Environment Canada Codes of Practice Effluent Quality

Loading reductions are achieved through treatment of neutralization sump and RLWMS effluent. The major reduction in TSS loading is attained through treatment of neutralization sump effluent; primarily the neutralization sump at Bruce-B which contributes 85% of the TSS loading from streams treated under this option (ie. neutralization sump, RLWMS, equipment cleaning and oily water separators).

Nuclear Stations: Partial Reduction of Toxic Streams

Loading reductions predicted under this option are increased by eliminating neutralization sump discharges. Reductions from RLWMS effluent are the same as the Environment Canada Codes of Practice Option. Additional loading reductions, primarily copper, zinc and iron, are achieved through recycle of boiler blowdown. Reductions from recycle of building effluent are due almost entirely to the higher flows and loadings monitored at Pickering.

Nuclear Stations: Minimum Discharge Option

Loading reductions predicted under the minimum discharge option, with the exception of Pickering, do not differ significantly from those predicted under the partial reduction of toxic streams option. Predicted reductions at Pickering are higher because building effluent at this station comprise a large part of the total station loading.

4.8.5 Loading Reductions - Nuclear Associated Facilities

Table 4.16 provides estimated loadings which are expected after implementation of each of the nuclear associated facility BAT options. The residual estimated loadings for the two options at the Bruce Heavy Water Plant were revised to exclude two storm water streams (control point 0700 & 0800) loadings that were included by the BAT consultant.

Nuclear Associated Facilities: Environment Canada Codes of Practice Effluent Quality

Bruce Heavy Water Plant

The bulk of the reduction in TSS loading predicted under the Environment Canada Codes of Practice Option is through recycle of filter backwash which is currently discharged to building effluent (control point BE 0100). Minor reductions in iron and zinc are achieved by recycle of filter backwash.

This BAT option also recommends routing of stormwater effluents which are not currently treated by the surface water treatment facility (SWTF) to the SWTF.

Bruce Nuclear Power Development Services

No additional treatment was prescribed under the Environment Canada Codes of Practice Option for BNPD; therefore, no reductions in loadings are expected.

Darlington NGS Construction Site

The only reductions in TSS loadings are achieved through treatment of construction boiler blowdown effluent. The major reduction in zinc under this option results from the recommendation to replace water cooled air compressors with air cooled units. Reductions in iron result from treatment of construction boiler blowdown and elimination of water cooled air compressors.

Nuclear Associated Facilities: Minimum Discharge Option

Bruce Heavy Water Plant

Loadings remaining after implementation of the minimum discharge option at BHWP are from process effluents PR 0500 and PR 0400 which cannot be recycled because they are depleted in D_2O. All other streams are recycled as input to the heavy water production process.

Bruce Nuclear Power Development Services

Loadings remaining after implementation of the minimum discharge option at BNPD are from the sewage treatment plant only. All other process streams are reused.

Darlington Construction

Loadings remaining after implementation of the minimum discharge option at Darlington Construction Site are from the sewage treatment plant only. All other process streams are reused.

Table 4.14

Predicted Effluent Loading and Costs for the Fossil Subcategory

Parameter	Units	Atikokan	Lakeview	Lambton	Lennox	Nanticoke	Thunder Bay
Baseline Effluent Loadings							
TSS	kg/yr	28090	187345	83636	953	606730	12700
Copper	kg/yr	10	83	97	43	423	29
Iron	kg/yr	713	485	1038	152	1518	623
BAT Option IA: Treatment of Quench/Seal Water Effluent							
Capital Costs	$(,000)	nil	13975	25006	nil	30824	nil
O&M Costs	$(,000/year)	nil	1330	2188	nil	2735	nil
TSS	kg/yr	28090	66345	50636	953	425730	12700
Copper	kg/yr	-	-	-	-	-	-
Iron	kg/yr	-	-	-	-	-	-
BAT Option I: Best in Ontario							
Capital Costs	$(,000)	15604	54730	52575	16250	114386	7723
O&M Costs	$(,000/year)	2366	4705	4182	1272	11291	1393
TSS	kg/yr	28090	66345	50636	953	372440	11629
Copper	kg/yr	9	83	97	43	422	20
Iron	kg/yr	687	485	574	65	803	621
BAT Option II: Environment Canada Codes of Practice Effluent Quality							
Capital Costs	$(,000)	30569	61775	72657	19161	150775	20042
O&M Costs	$(,000/year)	6306	7185	9239	2857	19269	4883
TSS	kg/yr	28090	66345	50562	953	372418	11629
Copper	kg/yr	9	83	97	43	422	19
Iron	kg/yr	687	484	559	65	802	621

Table 4.14 (continued)

Predicted Effluent Loading and Costs for the Fossil Subcategory

Parameter	Units	Atikokan	Lakeview	Lambton	Lennox	Nanticoke	Thunder Bay
BAT Option III: No Discharge of Toxic Effluent							
Capital Costs	$(,000)	30547	71316	79489	27487	158560	19966
O&M Costs	$(,000/year)	6297	9399	10408	3969	21254	4859
TSS	kg/yr	28090	66345	48153	953	372440	11629
Copper	kg/yr	6	4	48	11	97	19
Iron	kg/yr	686	478	538	61	733	616
BAT Option IV: Minimum Discharge - No Cooling Tower for Condenser Cooling Water							
Capital Costs	$(,000)	58154	287498	215864	221910	489115	67634
O&M Costs	$(,000/year)	12207	53154	53140	47575	93328	15543
TSS	kg/yr	25868	54628	34295	0	323165	9052
Copper	kg/yr	0	0	34	5	90	15
Iron	kg/yr	0	251	236	53	689	476
BAT Option V: Best in Canada - Zero Discharge							
Capital Costs	$(,000)	85474	381661	515756	535978	1006429	131176
O&M Costs	$(,000/year)	12207	53154	53140	47575	93328	15543
TSS	kg/yr	0	0	0	0	0	0
Copper	kg/yr	0	0	0	0	0	0
Iron	kg/yr	0	0	0	0	0	0

Table 4.15

Predicted Effluent Loading and Costs for the Nuclear Station Subcategory

Parameter	Units	Bruce-A	Bruce-B	Darlington	Pickering
Baseline Effluent Loadings					
TSS	kg/yr	447	36511	1694	126283
Copper	kg/yr	33	25	15	100
Zinc	kg/yr	22	11	31	153
Iron	kg/yr	130	349	286	2876
BAT Option I: Best in Ontario					
Capital Costs	$(,000)	11330	12524	5449	13708
O&M Costs	$(,000/year)	1445	215	2058	1760
TSS	kg/yr	447	36511	1694	126283
Copper	kg/yr	33	25	15	100
Zinc	kg/yr	22	11	31	153
Iron	kg/yr	130	349	286	2876
BAT Option II: Environment Canada Codes of Practice					
Capital Costs	$(,000)	24899	21469	22095	34924
O&M Costs	$(,000/year)	11172	10832	15071	15463
TSS	kg/yr	89	2065	675	123261
Copper	kg/yr	29	16	10	89
Zinc	kg/yr	11	8	15	130
Iron	kg/yr	50	128	206	2683
BAT Option III: Partial Reduction in Toxic Streams					
Capital Costs	$(,000)	59280	60285	63610	67455
O&M Costs	$(,000/year)	11172	10832	15071	15463
TSS	kg/yr	89	34	571	23068
Copper	kg/yr	1	3	2	60
Zinc	kg/yr	1	1	8	88
Iron	kg/yr	3	11	22	452
BAT Option IV: Minimum Discharge					
Capital Costs	$(,000)	619696	692780	475144	1139170
O&M Costs	$(,000/year)	106440	115000	67703	159235
TSS	kg/yr	89	34	255	292
Copper	kg/yr	0	0	0	1
Zinc	kg/yr	0	0	0	1
Iron	kg/yr	1	0	1	1

Table 4.16

Predicted Effluent Loading and Costs for Nuclear Associated Facilities

Parameter	Units	Bruce Heavy Water Plant	BNPD Services	Darlington Construction
Baseline Effluent Loadings				
TSS	kg/yr	61607	20988	3411
Copper	kg/yr	7	73	13
Zinc	kg/yr	589	101	260
Iron	kg/yr	2377	658	125
BAT Option I: Environment Canada Codes of Practice				
Capital Costs	$(,000)	1610	**	7556
O&M Costs	$(,000/year)	*	**	2376
TSS	kg/yr	23903	20988	2743
Copper	kg/yr	7	73	7
Zinc	kg/yr	567	101	14
Iron	kg/yr	1895	658	75
BAT Option II: Minimum Discharge				
Capital Costs	$(,000)	3420	58858	32650
O&M Costs	$(,000/year)	*	37923	6310
TSS	kg/yr	1022	4161	2145
Copper	kg/yr	0	20	5
Zinc	kg/yr	421	39	13
Iron	kg/yr	1337	62	72

* Piping additions required only to redirect flows through existing equipment.

** No additions required to meet Environment Canada Codes of Practice Effluent Quality

4.9 Economic Assessment Objectives

The objective of the economic assessment were to:

- evaluate the cost-effectiveness of the various wastewater treatment BAT options;
- show the incremental cost of successively higher levels of contaminant removal; and
- ascertain the potential economic and financial consequences of those BAT Options that are least-cost.

4.9.1 Cost Analysis Of BAT Options

Four analytical techniques were applied to analyze the potential costs of abatement technology options at each plant and their effects on the Ontario Hydro and the provincial economy.

The first technique involves derivation of least-cost abatement cost functions for each plant or support facility. The second analytical technique is the application of cost-effectiveness analysis to calculate the unit and marginal costs associated with each level of abatement and to identify which levels have the lowest of these measures.

4.9.2 Abatement Cost Functions

In order to compare and aggregate costs of various BAT Options at each plant or facility, one-time capital costs are annualized and added to recurring (annual) "operating, maintenance and administration" costs[1]. In this report, capital costs are annualized over twenty years for all facilities except nuclear plants where thirty years is used. These time periods are based on the estimated useful lives of existing plants. A nominal or current (not adjusted for inflation) interest rate of 9% is used in all calculations.

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[1]The general annualization formula is:

$$TAC = \{OM\&A * (1-T)\} + \{K * (i/[1-(i+1)-n]) * (1-T)\}$$

Where:

TAC	($/yr)	= Total Annualized Cost
OM&A	($/yr)	= Operating, Maintenance and Administrative Costs
K	($)	= Capital Cost
T	(T/100)	= Applicable Tax Rate
i	(i/100)	= Nominal Interest Rate
n	(years)	= Life of Abatement Equipment or System.

When T = 0, TAC represents the "before-tax" cost of the BAT Option which is also the cost to society; when T > 0, TAC represents "after-tax" cost which is borne by the polluter.

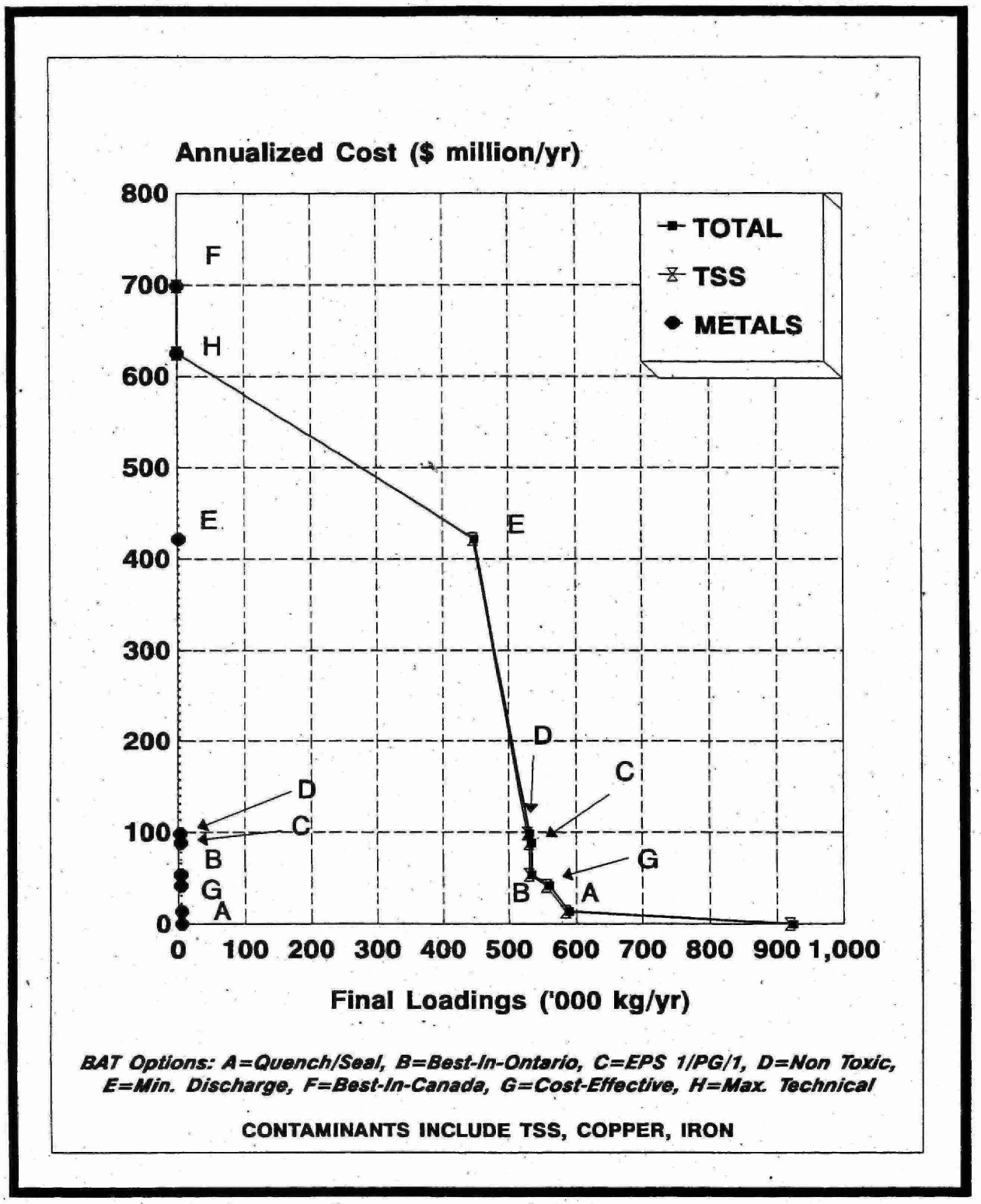


Figure 4.16: Aggregate Abatement Cost Functions Comparing Total Annualized Costs of BAT Options with Initial and Final Loadings for TSS, Total Metals and All Contaminants from the Fossil Subcategory

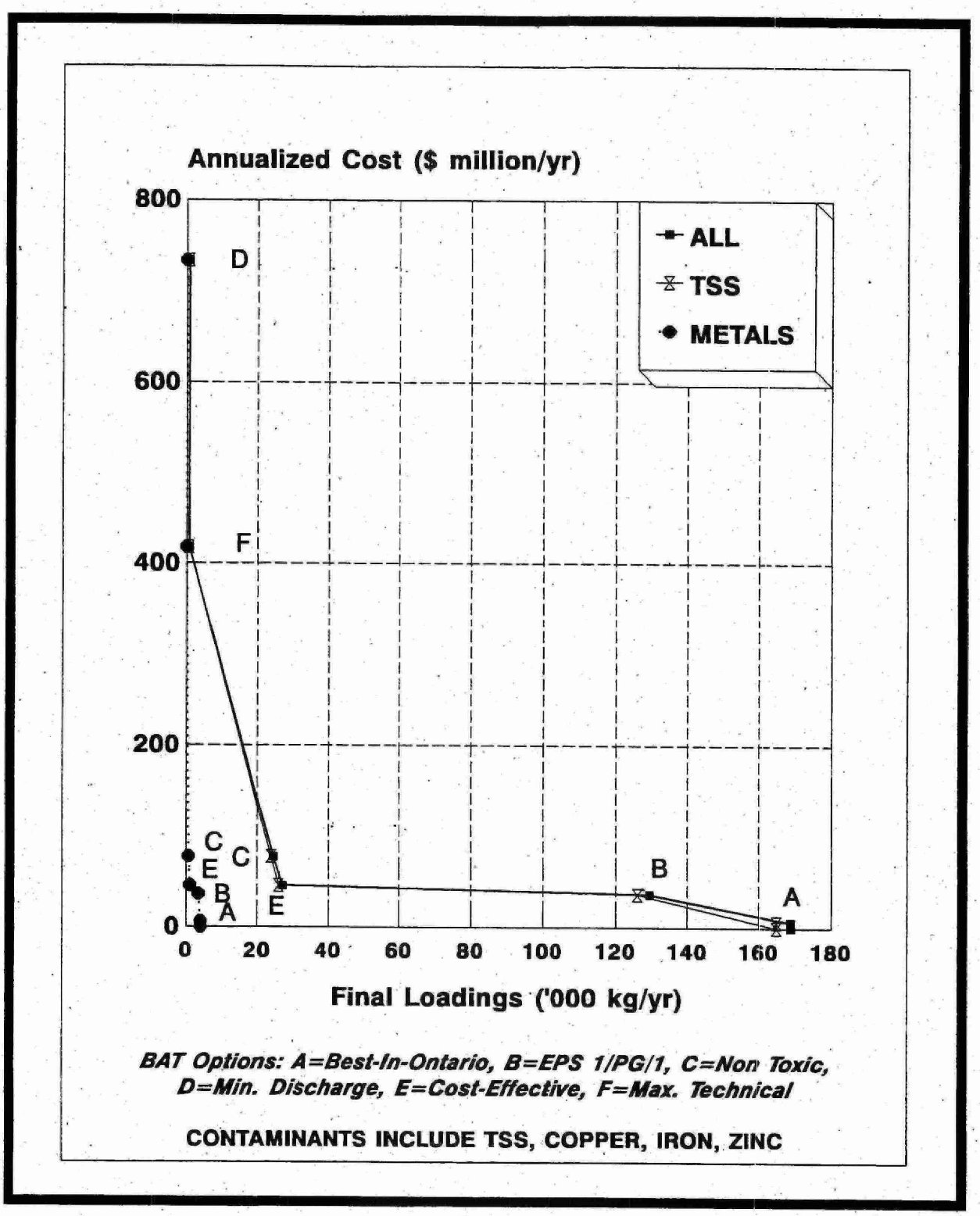


Figure 4.17: Aggregate Abatement Cost Functions Comparing Total Annualized Costs of BAT Options with Initial and Final Loadings for TSS, Total Metals and All Contaminants from Ontario Hydro Nuclear-Power Plants

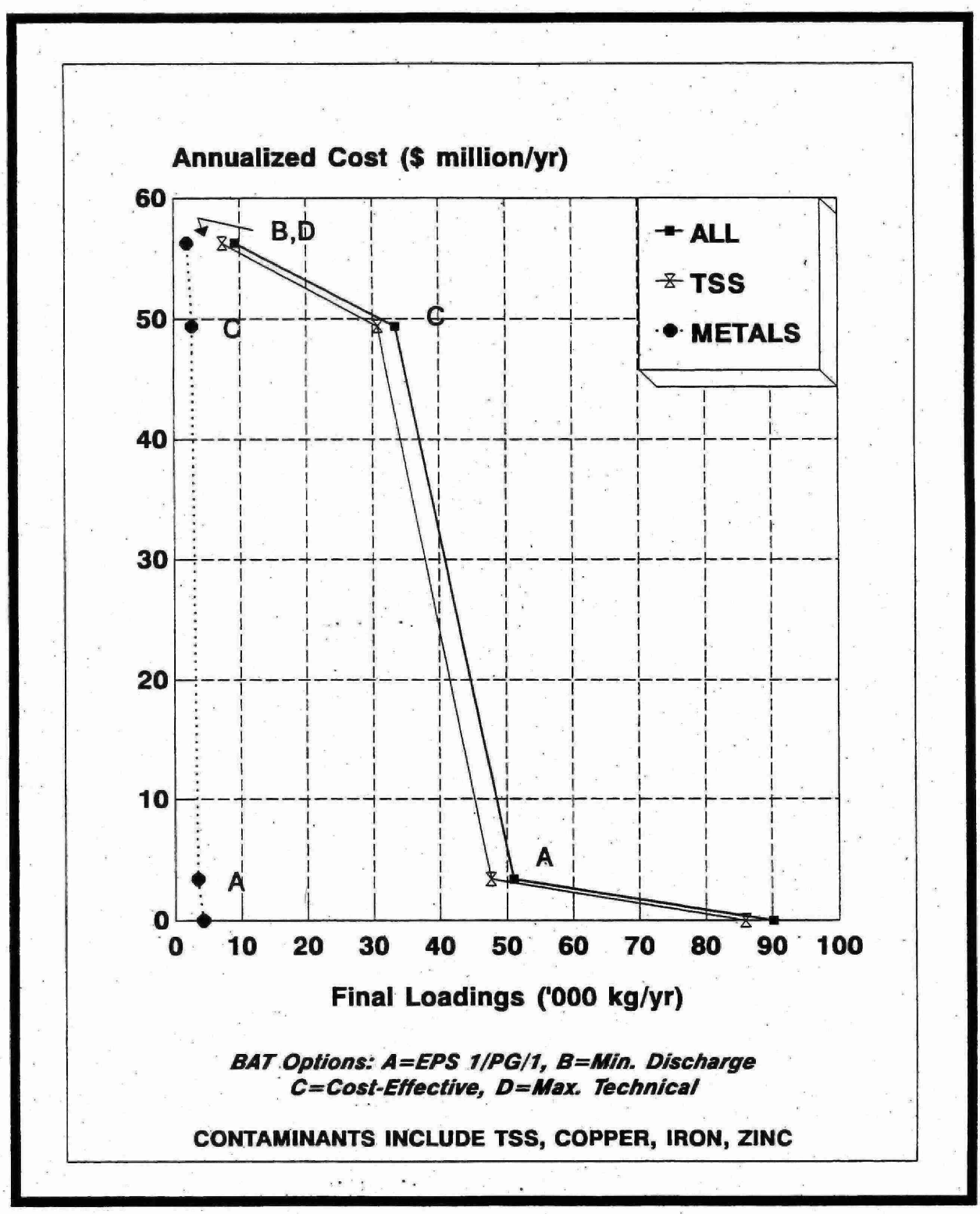


Figure 4.18: Aggregate Abatement Cost Functions Comparing Total Annualized Costs of BAT Options with Initial and Final Loadings for TSS, Total Metals and All Contaminants from the Nuclear Support Facilities

Abatement cost functions show capital, annual operating and total annualized costs associated with levels of potential contaminant reductions. These estimates can be displayed in graphic or tabular formats. Abatement cost functions can be generated for individual plants or for the entire sector.

To derive least-cost abatement cost functions for each plant, total annualized (amortized capital plus annual operation and maintenance costs) BAT option costs are graphed against aggregate reductions or final loadings at each plant by option. This comparison is required to show how different BAT Options identified for each plant achieve successively higher levels of contaminant reduction. Also, where more than one BAT option produces similar reductions at different costs, the BAT option that yields a given contaminant reduction for the lowest cost is used to derive the Least-Cost Abatement Cost Functions.

Cost functions can show clearly the lowest cost at which a given abatement objective or contaminant reduction goal can be achieved. In cases where only a limited number of abatement technologies are postulated, a specified loading limit or target reduction must be achieved by implementing the next technology combination which removes larger quantities of pollutant than that required by the loading objective.

The two polar benchmarks or loci on an abatement cost function are:

1. The "initial" or baseline loading of contaminants to be reduced. At this baseline loading, no incremental abatement cost is incurred.

2. The "maximum technically achievable" level of abatement is the level at which the largest possible contaminant reduction can be attained at least-cost without closing the plant.

4.9.3 Cost-Effectiveness Analysis

Cost-effectiveness analysis facilitates comparison of the economic efficiency of different BAT Options. Cost-effectiveness analysis involves computing average cost per unit of pollutant removed or the ratio of incremental cost per incremental unit of pollutant reduced[2].

The average unit cost is calculated with the following equation:

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[2]See Chapter 9 "Cost-Effectiveness Analysis" in Mark S. Thompson, 1980, Benefit-Cost Analysis for Program Evaluation, pp 221-248, See also, Chapter 8 "Measuring Efficiency" in Peter H. Rossi and Howard E. Freeman, 1982, Evaluation: A Systematic Approach, pp 267 - 297.

Unit Cost of Removal ($/kg) = [**Annualized Cost** ($/yr)]/[**Total Annual Reduction** (kg/yr)]

Marginal costs are the second order differentiation beyond average or unit costs and identify those technology combinations for which costs start to rise faster than contaminant reductions. Marginal cost per incremental reduction is calculated as follows:

Marginal Cost of Removal $(\Delta\$/\Delta kg) = [(\Delta\$/yr)/(\Delta kg/yr)] = [(C_2 - C_1)/(L_2 - L_1)]$

Where:
- C_1 = Total annualized cost of BAT Option "i" (BAT Option "1")
- C_2 = Total annualized cost of the next higher BAT Option "i+1" (BAT Option "2")
- L_1 = Loading reduction achieved by BAT Option "i" (BAT Option "1")
- L_2 = Loading reduction achieved by the next higher BAT Option "i+1" (Option "2")

4.9.4 Least-Cost Implementation Strategy

The following analytical procedure was applied in order to find the lowest cost configuration of abatement programs for all Ontario Hydro plants that will achieve the largest contaminant reductions for all 13 plants. The most cost-effective (lowest unit cost) BAT Options at each of the 13 Ontario Hydro plants/facilities were collated and sorted, lowest to highest, by unit costs, total annualized costs, and plant-specific capital costs, and then highest to lowest by total contaminant reduction.

4.9.5 Aggregate Abatement Scenarios

In order to evaluate the effects of potential abatement costs at specific levels of contaminant reductions on sector firms, the total contaminants removed and costs from each plant owned by each company were aggregated. Aggregate Abatement Scenarios are defined for which capital, O&M and annualized costs at each plant can be summarized by company and used to adjust financial data of sector firms.

The following rules were used to define Aggregate Abatement Scenarios and, the total costs associated with these scenarios were utilized in the financial analysis of the effects on Ontario Hydro:

1. Where technically feasible, the same BAT Options are applied at each plant. This procedure yields up to 6 Aggregate Abatement Scenarios.

2. At each plant, the BAT Option with the lowest unit cost is identified as the cost-effective option and are grouped into an Aggregate Abatement Scenario.

3. At each plant, the BAT Option that achieves the greatest contaminant reduction at least-cost is identified, and costs and removal estimates are used to define the Maximum Technically Achievable Abatement Scenario.

For Ontario Hydro, other site-specific abatement scenarios were developed to show the effects of flexibility in the implementation of a contaminant reduction program.

4.9.6 Financial Assessment: Corporate Financial Effects

Aggregate Abatement Scenario costs were used to compute the effects on the financial position of Ontario Hydro.

For Ontario Hydro, the analyses were carried out at the Corporate and Business Unit levels. At the Corporate level, effects on 5 indicators were assessed: Electricity Pricing, Borrowing Requirements, Debt Equity Ratio, Cash Flow Coverage and Interest Coverage. At the Business Unit level the following five financial indicators were evaluated: Return of Assets, Return of Capital (Employed), Total Debt to Total Assets, Net Internal Cash Flow and Net Income.

4.9.7 Ontario Hydro Business Units

Ontario Hydro has identified within its operation business units with clear accountabilities, including specific rates of turn and cost control. These business units include two of the sub-categories of the electric power generation sector: (Ontario Hydro) Fossil and Nuclear Business Units. Among the principles that will govern the operation of these business units are the following[3]:

- each unit will be responsible for its own profit and loss statement;

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[3] **The Corporate Structure of Ontario Hydro** (Ontario Hydro, April 7, 1993) recommended by the Chairman and Chief Executive Officer, used in Ontario Hydro presentation to the Electric Power Generation Sector Joint Technical Committee (JTC), 1993.

- affordability testing of new capital expenditures;
- minimize the need for rate increases, and to reduce debt and fixed cost;
- environmental and social costs are to be integrated into decision-making;
- price will dictate cost; that is, ensuring the competitive price of Ontario Hydro products and services to customers will determine the level of costs which may be passed through to them; and
- the relationship between business units and between the Corporation and its business units will be delineated in contracts.

A number of financial indicators were identified that can help assess these performance criteria and show how they may be affected by the potential water pollution abatement costs.

4.9.8 Economic Assessment Procedures

To estimate the potential impacts of the MISA-induced costs on the Ontario economy, the Ontario Hydro Economic Model was used. Based on 1984 Statistics Canada Interprovincial Input-Output Matrices, this model can estimate direct, indirect and induced economic consequences. The Ontario Hydro economic model is a static model based on 5-year lag historical data. Input data used are consistent with those of Statistics Canada and the outputs can be disaggregated by industry and commodity. However, for this assessment only aggregate or economy-wide impacts were assessed because the available BAT Option costs data are not disaggregated enough and such simulation is highly time consuming. Specifically, the model was used to estimate provincial employment and gross domestic product (GDP) impacts.

4.9.9 Results of the Cost-Effectiveness Analyses

Fossil Plants BAT Options

The results of the cost-effectiveness analysis portion of the Economic Assessment Study[11] carried out by the Ministry EPGS Economic Assessment Subcommittee concluded that the Ash Quench/Boiler Seal water option showed the lowest average cost for the removal of one kilogram of total suspended solids ($41/kg) (see table 4.18 below).

Nuclear Plants BAT Options

The results of the cost-effectiveness assessment of BAT options for nuclear stations indicates that the Environment Canada Codes of Practice Option is the most cost-effective option on which to base effluent limits for Bruce-A, Bruce-B and Darlington stations whereas the Partial Reduction of Toxic Streams Option is the most cost effective option on which to base effluent limits for Pickering NGS.

Under the Environment Canada Codes of Practice Option for nuclear stations, additional treatment is prescribed for neutralization sump, radioactive liquid waste management system and equipment cleaning effluents (ie. boiler layup). Treatment for boiler blowdown and building effluent is not prescribed under this option.

Under the Partial Reduction of Toxic Streams Option, neutralization sump effluent is eliminated, boiler blowdown and building effluent are treated by physical/chemical treatment and reused. Treatment of RLWMS effluent is identical to the Environment Canada Codes of Practice Option.

The LSS agreed that because building effluent at Pickering is comprised primarily of cooling water it should not be considered in assessing loading reductions for this BAT option. If building effluent at Pickering is excluded from the economic assessment then the Environment Canada Codes of Practice Option forms a more cost effective basis for setting effluent limits at Pickering than the Partial Reduction of Toxic Streams Option.

Nuclear Associated Facility BAT Options

The economic assessment identified the Environment Canada Codes of Practice Option as the most cost-effective option for the Bruce Heavy Water Plant and the Darlington Construction Site. The minimum discharge option was identified as most cost effective for Bruce Nuclear Power Development Services. The use of each of these options in development of effluent limits is discussed in section 5.

Table 4.17[11]
Comparison of Aggregate BAT Options Annualized Costs and Contaminant Loadings

Sectoral Aggregate Scenario	Cost			Initial and Final Loadings (kg/yr)			
	OM&A ($/yr)	Capital ($)	Annualized ($/yr)	TSS	Copper	Iron	Zinc
Ontario Hydro Fossil Plants	**Initial Loadings**			919,454	685	4,529	--
Ash Quench/Boiler Seal	6,252,857	69,804,661	13,899,712	584,454	685	4,529	--
Best-In-Ontario	25,209,015	261,268,739	53,830,084	530,093	674	3,235	--
Environment Canada Codes Practice	49,739,432	354,979,524	88,626,188	529,997	673	3,218	--
Non-Toxic	56,186,280	387,365,415	98,620,796	527,610	185	3,112	--
Minimum Discharge	274,993,952	1,340,175,344	421,805,437	447,008	144	1,705	--
Best-In-Canada	407,801,161	2,656,473,244	698,808,441	0	0	0	--
Ontario Hydro Nuclear Plants	**Initial Loadings**			**164,935**	**173**	**3,641**	**217**
Best-In-Ontario	5,478,048	6,810,996	6,141,005	164,935	173	3,638	217
Environment Canada Codes of Practice	26,223,886	103,387,919	36,287,289	126,090	144	3,067	164
Non-Toxic	52,537,215	250,630,647	76,932,688	23,762	66	488	98
Minimum Discharge	448,379,107	2,926,789,955	733,262,270	670	1	3	1
Ontario Hydro Associated Facilities	**Initial Loadings**			86,006	93	3,160	950
Environment Canada Codes Practice	2,375,506	9,165,123	3,379,513	47,634	87	2,628	682
Minimum Discharge	44,233,599	109,928,629	56,275,893	7,328	25	1,471	473

Table 4.18[11]
Sectoral Aggregate Cost-Effectiveness Ratios and Rank-Ordering of BAT Options

Sectoral Aggregate Scenario	Annualized Costs ($/Yr)	Cost-effectiveness Ratios or Average Costs ($/kg)			Ordinal Rank-ordering		Whether Least-Cost Abatement Scenario	Number of Plants
		TSS	Metals	All Contaminants	Contaminant Reductions♣	Cost-effectiveness (all contaminants)		
Ontario Hydro Fossil Plants								
Ash Quench/Boiler Seal	13,899,712	*41	--	*41	8	1	Yes	3
Best-In-Ontario	53,830,084	138	41,249	138	6	3	Yes	6
Env. Can. Codes	88,626,188	228	66,989	227	4	4	No	6
Non Toxic	98,620,796	252	51,445	251	5	5	Yes	6
Minimum Discharge	421,805,437	893	125,350	887	3	8	Yes	6
Best-In-Canada	698,808,441	760	176	754	1	7	Yes	6
Cost-Effective (composite)	41,797674	115	50,911	115	7	2	Yes	6
Maximum Tech. (composite)	625,223,952	680	121,191	676	2	6	Yes	6
Ontario Hydro Nuclear Plants								
Best-In-Ontario	6,141,005	--	**2,042,002	**2,047,002	6	6	No	4
Env. Can. Codes	36,287,289	934	55,316	919	5	3	Yes	4
Non-Toxic	76,932,688	545	22,768	367	3	2	Yes	4
Minimum Discharge	733,262,163	4,464	182,132	4,357	1	5	Yes	4
Cost-Effective (composite)	45,504,147	51	15,417	321	4	1	Yes	4
Maximum Tech. (composite)	45,947,386	2,543	90,484	2,482	2	4	Yes	4
Ontario Hydro Nuclear Associated Facilities								
Env. Can. Codes	3,379,513	88	4,193	86	4	1	Yes	3
Minimum Discharge	56,275,893	715	25,191	696	1	2	Yes	3
Cost-Effective (composite)	49,393,701	895	32,560	871	3	4	Yes	3
Maximum Tech. (composite)	56,275,893	694	24,455	696	1	2	Yes	3

* TSS only ** Metals only ♣ See Table 4.11 -- No reduction

Table 4.19[11]
Marginal Cost of BAT Options and Rank-Ordering

Sectoral Aggregate Scenario	Annualized Costs ($/yr)	Cost-effectiveness♣		Marginal Cost♣		Number of Plants
		Ratio ($/kg)	Ordinal Rank	Ratio ($/kg)	Ordinal Rank	
Ontario Hydro Fossil Plants						
Ash Quench/Boiler Seal	13,899,712	*41	1	*41	1	3
Cost-Effective (composite)	41,797,674	115	2	930	4	6
Best-In-Ontario	53,830,084	138	3	489	3	6
Environment Canada Codes of Practice	88,626,188	227	4	305,229	7	6
Non Toxic	98,620,796	251	5	3,353	5	6
Minimum Discharge	421,805,437	887	8	3,939	6	6
Maximum Tech. (composite)	625,223,952	676	6	453	2	6
Best-In-Canada	698,808,441	754	7	1,268,698	8	6
Ontario Hydro Nuclear Plants						
Environment Canada Codes of Practice	36,287,289	919	3	919	2	4
Cost-Effective (composite)	45,504,157	321	1	90	1	4
Non Toxic	76,932,688	367	2	12,296	3	4
Maximum Tech. (composite)	417,711,573	2,482,	4	14,367	4	4
Minimum Discharge	733,262,163	4,357	5	16,607,926	5	4
Ontario Hydro Associated Facilities						
Environment Canada Codes of Practice	3,379,513	86	1	86	1	3
Cost-Effective (composite)	49,393,701	871	4	2,634	4	3
Minimum Discharge	56,275,893	696	2	284	2	3
Maximum Tech. (Composite)	56,275,893	696	2	284	2	3

* TSS only ♣ Based on total reduction (all contaminants)

4.9.10. Results of the Assessment of Potential Financial Effects of Postulated BAT Options

Using the algorithms provided by Ontario Hydro, potential aggregate financial and price impacts due to potential abatement requirements were estimated and the results are shown in **Table 4.20**. These results show potential contributory cost impacts on the fossil and nuclear sub-categories, and the support facilities separately. To get total corporate impacts, cost effects from the fossil, nuclear and support facilities subcategories can be added in various permutations to reflect given implementation scenarios. For example, to get the effect of the lowest cost level of abatement effort, the aggregate scenario selected under the fossil sub-category is Quench/Seal aggregate scenario, for nuclear plants the Best-in-Canada aggregate scenario and, for support facilities the Environment Canada Codes of Practice aggregate scenario, the corporate aggregate impacts is the summation of these subcategory impacts. This level of abatement expenditures potentially, could cause upward pressures on electricity rates equivalent to a 0.28% rate increase (i.e., .175% + 0.064% + 0.038%) in order to recover the increased costs. Using the cost-effective aggregate scenario level of expenditure, electricity rates could potentially increase by 1.58%, while the "maximum reduction technically achievable" level of expenditure implies a revenue requirement equivalent to a 13.35% rate increase. As indicated earlier, the effects from MISA-monitoring will have to be added to the abatement effects.

Although, some financial indicators may not change significantly, the key indictor electricity prices show noticeable increases. Borrowing requirements under aggregate abatement scenarios, except in three cases, would cause only small increases in Ontario Hydro's debt position because the firm's current debt load of $35 billion and the incremental borrowings represent only small fractions of that total debt load.

Specifically, these results show the range of potential effects of various aggregate abatement scenarios at the subcategory and corporate levels and the extent to which electricity rates may have to be increased to recover or match revenue requirements.

Table 4.20
Ontario Hydro: MISA Costs Effects On Key Financial Indicators By Aggregate Abatement Scenarios and Subcategory

Aggregate Scenarios by Subcategory	MISA Costs			Financial Indicators							
	Capital	OM&A	Annualized	Depreciation	Interest	Revenue Requirement	Electricity Price Increase	Borrowing	Debt Ratio	Interest Coverage	Cash Flow Coverage
	$M	$M/yr		$M			%	$M	Times		
Baseline (Before MISA)	0	0	0	0	0	0	6.52	3,600	0.83	1.15	1.04
Ontario Hydro Totals											
Quench/Seal	69.8	6.3	13.9	3.5	6.3	16.1	0.175	69.8	0.00	0.00	0.00
Best-in Ontario	268.1	30.7	60.0	13.3	24.1	68.1	0.736	268.1	0.00	0.00	(0.01)
Environment Canada Codes	467.5	78.3	128.3	21.5	42.1	141.9	1.539	467.5	0.00	0.00	(0.01)
Non-Toxic Effl.	638.0	108.7	175.6	27.7	57.4	193.8	2.109	638.0	0.00	(0.01)	(0.02)
Min. Discharge	4,376.9	767.0	1,211.3	168.2	393.9	1,329.1	14.454	4,376.9	0.02	(0.03)	(0.10)
Best-in-Canada	2,656.5	407.8	698.8	132.8	239.1	779.7	8.475	2,656.5	0.01	(0.02)	(0.06)
Cost-Effective	398.2	94.8	136.8	16.2	35.8	146.8	1.597	398.2	0.00	0.00	(0.01)
Maximum Technical	4,186.2	673.1	1,099.2	178.6	376.8	1,228.5	13.353	4,186.2	0.02	(0.03)	(0.09)
Nuclear Plant Sites											
Bruce Site C/E	100.2	44.3	54.9	3.3	9.0	56.6	0.615	100.2	0.00	0.00	0.00
Darlington Site C/E	54.7	12.9	12.9	1.8	4.9	19.6	0.213	54.7	0.00	0.00	0.00
Pickering Site C/E	67.5	15.5	22.0	2.2	6.1	23.8	0.259	67.5	0.00	0.00	0.00

Table 4.20 (cont'd.)
Ontario Hydro: MISA Costs Effects On Key Financial Indicators By Aggregate Abatement Scenarios and Subcategory

Aggregate Scenarios by Subcategory	MISA Costs			Financial Indicators							
	Capital	OM&A	Annualized	Depreciation	Interest	Revenue Requirement	electricity Price Increase	Borrowing	Debt Ratio	Interest Coverage	Cash Flow Coverage
	$m	$m/yr		$M			%	$M	Times		
Baseline (Before MISA)	0	0	0	0	0	0	6.52	3,600	0.83	1.15	1.04
Fossil Plants											
Quench/Seal	69.8	6.3	13.9	3.5	6.3	16.1	0.175	69.8	0.00	0.00	0.00
Best-in Ontario	261.3	25.2	53.8	13.1	23.5	61.8	0.672	261.3	0.00	0.00	(0.01)
Environment Canada Codes	355.0	49.7	88.6	17.7	31.9	99.8	1.079	335.0	0.00	0.00	(0.01)
Non-Toxic Effl.	387.4	56.2	98.6	19.4	34.9	110.5	1.201	387.4	0.00	0.00	(0.01)
Min. Discharge	1,340.2	275.0	421.8	67.0	120.6	462.6	5.028	1,340.2	0.01	(0.01)	(0.03)
Best-in-Canada	2,656.5	407.8	698.8	132.8	239.1	779.7	8.475	2,656.5	0.01	(0.02)	(0.06)
Cost-Effective	179.3	22.2	41.8	9.0	16.1	47.3	0.514	179.3	0.00	0.00	0.00
Maximum Technical	2,342.4	379.9	625.2	117.1	210.8	707.8	7.693	2,342.4	0.01	(0.02)	(0.05)
Nuclear Plants											
Best-in-Ontario	6.8	5.5	6.1	0.2	0.6	6.3	0.064	6.8	0.00	0.00	0.00
Environment Canada Codes	103.4	26.2	36.3	3.4	9.3	38.9	0.422	103.4	0.00	0.00	0.00
Non-Toxic Effl.	250.6	52.5	76.9	8.4	22.6	83.5	0.908	250.6	0.00	0.00	(0.01)
Min. Discharge	2,966.8	448.4	733.3	97.6	263.4	809.4	8.798	2,926.8	0.01	(0.02)	(0.07)
Cost-Effective	135.9	32.4	45.6	4.5	12.23	49.1	0.534	135.9	0.00	0.00	0.00
Maximum Technical	1,733.9	248.9	417.7	57.8	156.0	462.7	5.029	1,733.9	0.01	(0.01)	(0.04)
Nuclear Support Facilities											
Environment Canada Codes	9.2	2.4	3.4	0.3	0.8	3.5	0.038	9.2	0.00	0.00	0.00
Min. Discharge	109.9	44.2	56.3	3.7	9.9	57.8	0.628	109.9	0.00	0.00	0.00
Cost-Effective	83.0	40.3	49.4	2.8	7.5	50.5	0.549	83.0	0.00	0.00	0.00
Maximum Technical	109.9	44.2	56.3	3.7	9.9	57.8	0.628	109.9	0.00	0.00	0.00

4.9.11 Business Unit Impacts

A number of financial indicators were identified that can be used to estimate the financial effects of potential MISA abatement cost of the Fossil and Nuclear Business Units. The measures identified include "return on assets", "return on capital", "net income", "total debt to assets" and "net internal cash flow".

To estimate potential MISA cost impacts, proforma financial data of the two business units were adjusted with aggregate abatement costs. The results are shown in **Table 4.21** and **Table 4.22**

Table 4.21
MISA BAT Option Cost Impacts on the Fossil Business Unit

Aggregate Abatement Scenario	Return on Assets (%)	Return on Capital (%)	Total Debt to Total Assets	Net Internal Cash Flow ($m)	Net Income ($m)	Change in Net Income ($m)
Baseline (before MISA)	7.0	2.3	0.81	320	24	0
Quench/Seal	6.6	0.4	0.81	308	5	(19)
Best-in-Ontario	5.5	(4.8)	0.83	271	(51)	(75)
Env. Canada Codes	4.6	(8.8)	0.85	238	(93)	(117)
Partial Non-Toxic Effluent	4.3	(10.0)	0.85	229	(106)	(130)
Minimum Discharge	(2.3)	(47.7)	0.95	(76)	(506)	(530)
Best-in-Ontario	(5.9)	(83.7)	1.02	(327)	(889)	(913)

The estimated potential effects on the fossil business unit show deterioration in all measures expect "Total Debt To Total Assets" for the lowest cost abatement scenario. Net income is negative at the "Best-in-Ontario" abatement level. This is reflected in "Return on Capital" which changes to negative 4.8% from positive 2.3%. Subsequent higher abatement levels result further deterioration of the other financial measures.

The financial effects on the nuclear business unit appear to be less dramatic in most of the measures assessed except "Net Income". However, a marked change is observed in all measures at the "Minimum Discharge" abatement level, which is the highest cost abatement scenario. Evidently, it is only at this level that "Net Income" becomes negative, changing to negative $817 million from positive $120 million.

Table 4.22
MISA BAT Option Cost Impacts on the Nuclear Business Unit

Aggregate Abatement Scenario	Return on Assets (%)	Return on Capital (%)	Total Debt to Total Assets	Net Internal Cash Flow ($M)	Net Income ($M)	Change in Net Income ($M)
Nuclear Plants						
Baseline (before MISA)	8.7	9.6	0.93	1,072	120	0
Best-in-Ontario	8.7	9.6	0.93	1,065	113	(7)
Environment Canada Codes	8.5	9.5	0.93	1,039	81	(39)
Partial Non-Toxic Effluent	8.3	9.3	0.93	1,000	27	(93)
Minimum Discharge	5.6	6.3	0.96	391	(817)	(937)
Support Facilities						
Environment Canada Codes	8.7	9.6	0.93	1,069	117	(3)
Minimum Discharge	8.5	9.4	0.93	1,019	58	(62)

4.9.12 Economy-Wide Impacts of Potential MISA Abatement Investment

Ontario Hydro is the largest economic entity in Ontario after the Provincial Government. Consequently, its investments and other corporate decisions can have significant implications for the province, its residents, environment and economy. Funds that Ontario Hydro might send on MISA compliance can contribute between $27 million and $2.2 billion (1996$) to the provincial gross domestic product (GDP) and generate between 300 and 41,000 person-years of employment (**Table 4.23**). Actual impacts on the provincial GDP and employment will depend on the abatement scenario that is applied to Ontario Hydro plants and facilities.

Using Hydro's inter-provincial input-output model, described in Chapter 2, the sum of direct, indirect and induced impacts of potential MISA-required capital and OM&A expenditures are estimated. Direct impacts include the GDP and employment effects of Ontario Hydro purchases of water pollution abatement equipment and services (first round spending), indirect impacts are generated by manufacturers' expenditures to (component suppliers, contractors) satisfy or supply Ontario Hydro purchases (also called second round spending), while induced impacts are brought about by the infusion of salary and wages into the provincial economy by employees of Ontario Hydro and the manufacturers.

Aggregate potential impacts are shown in 1996 dollars (1996$), the year assumed for compliance with MISA abatement program. That year is not of any particular significance, a target year is required to complete the economic impact assessment. This assessment assumes a minimum of three years grace before regulated compliance with MISA abatement program's effluent limits once promulgated. The economy effects highlighted in **Table 4.23** are proportional to the expenditure requirements of individual aggregate abatement scenarios. The larger the economic effects the greater the cost of the achieving that abatement level.

Table 4.23
Economy-Wide Impacts of Potential MISA-Induced Expenditures

BAT Option	Estimated Economy-Wide Impacts	
	Gross Domestic Product (1996 $million)	Employment Person-Years
Ontario Hydro Total Impacts		
Quench/Seal	27	336
Best-In-Ontario	144	1,851
Environment Canada Codes	286	4,243
Cost-Effective	179	3,457
Partial Non-Toxic	339	5,629
Minimum Discharge	2,040	40,422
Best-In-Canada	1,890	30,237
Maximum Technical	2,218	40,933
Fossil Plants		
Quench/Seal	27	336
Best-In-Ontario	140	1,751
Environment Canada Codes	243	3,248
Cost-Effective	128	2,041
Partial Non-Toxic	266	3,630
Minimum Discharge	1,108	18,747
Maximum Technical	1,667	26,662
Best-In-Canada	1,890	30,237
Nuclear Plants		
Best-In-Ontario	4	100
Environment Canada Codes	32	815
Cost-Effective	40	1,084
Partial Non-Toxic	73	1,999
Minimum Discharge	918	21,235
Maximum Technical	537	13,831
Support Facilities		
Environment Canada Codes	10	180
Cost-Effective	11	332
Minimum Discharge	14	440
Maximum Technical	14	440

4.9.13 Financial Implications of the Draft EPGS Regulation:

Ontario Hydro was requested to review the final draft EPGS regulation and estimate the cost of implementing it. In their letter[13] dated October 5, 1994, Ontario Hydro provided the following revised estimates:

Item	Fossil, $ million	Nuclear, $ million
Capital(1994)	75.0 ± 10%	35.0 to 70.0
OM&A	4.0 ± 10%	7.0 to 10.0

The estimates were reviewed by the MOEE Economic Services Branch who provided the following financial implications summary statement.

To achieve the effluent quality required under the recommended limits, Ontario Hydro has estimated that capital expenditures could range between $103 - $153 million, plus $11 - $15 million/year in operation, maintenance and administration costs (OM&A), for a total annualized cost between $22 - $31 million/year over 20 years.

These cost estimates represent the high end of the potential costs Hydro might incur. Hydro has stated in a letter[13] to Ministry staff ". . . ***however, fossil GSs may find other more cost-effective methods to comply with the requirements of the draft regulation.***"

Up to 66% of the estimated capital costs would be borne by the fossil business unit (FBU), between $68-$83 million; or $11-$13 million/year total annualized cost. The OM&A costs for FBU are estimated between $4-$5 million/year.

Costs to the nuclear business unit (NBU) are estimated at $35-$70 million in capital, $7-$10 million/year in OM&A, and $11-$18 million/year in total annualized costs.

If this level of expense flows through to Hydro customers as increased electricity prices, bulk electricity rates could increase between 0.4% and 0.5%. On the other hand, if Hydro were to absorb these costs, with no increase in electricity rates, Hydro's net income would be reduced by $22- $31 million each year over a 20-year period, assuming capital funds are borrowed.

Alternately, if there are no rate increases and Hydro uses its own financial resources during the year in which the equipment/facilities are installed, annual net income could drop

by as much as $167 million in the implementation year and $11-$15 million in subsequent years depending on operating costs.

These estimated costs, which could be as low as $22-$31 million/year, represent about 6% - 8% of Hydro's annual environmental expenditures, which were $448 million in 1993 and averaged $378 million between 1988 and 1993. In the worst case scenario, where Hydro would expense $167 million MISA-related expenditures in one year, those expenditures would represent 44% of the average annual environmental expenditures over the last six years or 37% of its 1993 environmental expenditures. The projected MISA costs would not put Ontario Hydro in a loss position. Hydro's planned net income for 1994 is $606 million. However, by the end of August 1994, net income was projected at $375 million above plan. If electricity sales remain strong to the end of 1994, Hydro could realize a net income of about $1 billion. Hydro's forecast net incomes in 1995, 1996 and 1997 are $688 million, $885 million and $650 million, respectively.

4.10 References

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2 AWT/Metcalf & Eddy, Evaluation of Best Available Technologies for the EPGS Subcategory A: Fossil & Hydraulic Stations, June 1993 (unpublished).

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4 Environment Ontario, MISA Issues Resolution Process, Issue Resolution Committee Reports, June 1990, ISBN 0-7729-7354-7.

5 Environment Canada, Environmental Codes of Practice for Steam Electric Power Generation - Design Phase, March 1985, Report EPS 1/PG/1.

6 Letter from Ontario Hydro to MOEE re: Quench/Seal Effluent Loadings, August 25, 1993, TOB 07293 T3.

7 Letter from Ontario Hydro to MOEE re: Quench/Seal Effluent Loadings, August 18, 1993, TOB 07293 T2.

8 Letter from Ontario Hydro to MOEE, July 21, 1993, File 9580729373.

9 Letter from AWT/M&E, September 17, 1993.

10 Attachment #5 of Minutes of Limit Setting Subcommittee (LSS) Meeting of September 24, 1993.

11 Ontario Ministry of Environment & Energy, Draft MISA Economic Assessment: Potential Water Pollution Abatement Programs for Ontario Electric Power Generation Sector, Toronto, 1994 (unpublished).

12 Letter from Ontario Hydro to MOEE re: Quench/Seal Water, January 27, 1994, TOB 07293 T4.

13 Letter from Ontario Hydro to MOEE re: MISA COST/LOADING ESTIMATES, October 5, 1994, FBU 07293 T4

Section 5

Electric Power Generation Sector
Effluent Limits

Section 5
Effluent Limits

Contents

Section		Page
5.0	**Development of Effluent Limits for the Electric Power Generation Sector**	1
5.1	**The Form of Effluent Limits**	1
	5.1.1 Method 1: Linear Method (production based)	2
	5.1.2 Method 2: Average Loading Method	4
	5.1.3 Method 3: Average Concentration Method	6
	5.1.4 Selection of the Form of Limits	6
5.2	**Best Available Technology (BAT) Basis for Effluent Limits**	6
5.3	**Effluent Streams and Parameters to be Limited**	8
	5.3.1 Preliminary Selection of Candidate Parameters for Limits	8
	5.3.2 QA/QC Assessment of Monitoring Data	17
	5.3.3 Assessment of Control Through Selected BAT	17
	5.3.3.1 Assessment of Candidate Parameters for Possible Surrogates	19
	5.3.3.2 Assessment of Special Parameters	21
	5.3.4 Exclusion of Boiler Blowdown from the Regulation	23
	5.3.5 Assessment Monitoring of Building Effluent	28
5.4	**Effluent Limits Setting**	29
	5.4.1 Statistical Analysis of MISA Monitoring Data	30
5.5	**Effluent Limits for the Fossil Stations Subcategory**	32
	5.5.1 Ash Quench/Boiler Seal Water Effluent	32
	5.5.2 Ash Transport Water Treatment System Effluent	32
	5.5.3 Oily Water Separator Effluent	36
	5.5.4 Event Discharges	37
	5.5.5 WTP - Neutralization Sump Effluent	39
5.6	**Effluent Limits for the Nuclear Stations**	40
	5.6.1 Radioactive Liquid Waste Management System Effluent	41
	5.6.2 Neutralization Sump Effluent	43
	5.6.3 Oil/Water Separator Effluent	46

Table		Page
Effluent Limits for Nuclear Associated Facilities		47
5.7	**Effluent Limits for the Bruce Heavy Water Plant**	47
	5.7.1 Building Effluent, Control Point BE 0100	47
	5.7.2 Storm Waters, Control Points SW 0700 and SW 0800	47
	5.7.3 Surface Water Treatment Facility (SWTF) Control Point - 0600	48
	5.7.4 Process Effluent and Effluent Lagoons Effluent Control Points PR 0500 & PR 0400	48
5.8	**Effluent Limits for Bruce Nuclear Power Development Services**	51
	5.8.1 Steam Transformer Plants Control Points - 0200, 0300 & 0400	52
	5.8.2 Radioactive Waste Storage Site Control Point - 1300	52
	5.8.3 Chemical Waste Pond Control Point - 0600	52
	5.8.4 Neutralization Sump Control Point - 1400	52
	5.8.5 Sewage Treatment Plant Control Point - 0100	53
5.9	**Effluent Limits for the Darlington Construction Site**	53
	5.9.1 Neutralization Sump	53
	5.9.2 Boiler Blowdown	53
	5.9.3 Equipment Cleaning Effluent	54
	5.9.4 Sewage Treatment Plant	54
5.10	**Assessment Monitoring of Cooling Water Effluent**	58
5.11	**Overall Implications of MISA Effluent Limits for the Fossil and Nuclear Station Subcategories**	59
5.12	**Comparison to Other Jurisdictions**	60
5.13	**References**	65
Appendix to Section 5		67

List of Tables

Table		Page
5.1	Fossil Station Ash Transport Water Treatment Systems	5
Preliminary Selection of Candidate Parameters for Effluent Limits - Fossil Stations		
5.2	Ash Transport Water Treatment System Effluent	9
5.3	Coal Pile Effluent	10
5.5	Neutralization Sump Effluent	11
5.5	Oily Water Separator Effluent	12
Preliminary Selection of Candidate Parameters for Effluent Limits - Nuclear Stations		13
5.6	Radioactive Liquid Waste Management System Effluent	14
5.7	Neutralization Sump Effluent	15
5.8	Oily Water Separator Effluent	16
5.9	Preliminary Selection of Candidate Parameters for Effluent Limits - Nuclear Associated Facilities	16

List of Tables (continued)

Table		Page
Candidate Parameters for Limits Based on BAT Option Assessment		
5.10	Candidate Parameters Fossil Stations	18
5.11	Candidate Parameters Nuclear Stations	18
5.12	Candidate Parameters Nuclear Associated Facilities	19
5.13	Detection of Copper, Cadmium, Nickel and Zinc in Fossil Subcategory Effluents	20
5.14	Summary of PCBs (total) Data	22
5.15	Summary of Boiler Treatment Chemicals Used in the Electric Power Generation Sector	25
5.16	Summary of BAT Treatment of Boiler Blowdown Effluent	26
5.17	U.S. EPA Limits for Boiler Blowdown Effluent	26
5.18	Legend for Symbols Used in Table of Effluent Monitoring Performance Data	31
5.19	Ash Transport Water Treatment System Effluent Concentration Performance Data	35
5.20	Oily Water Separator Effluent Concentration Performance Data	37
5.21	Coal Pile Effluent Concentration Performance Data	38
5.22	Neutralization Sump Effluent Concentration Performance Data	40
5.23	Radioactive Liquid Waste Management System Effluent Concentration Performance Data	42
5.24	Fossil Station Subcategory Concentration Limits for ATWTS/Neutralization Sump Effluent	44
5.25	Neutralization Sump Effluent Concentration Performance Data	45
5.26	Oil/Water Separator Effluent Concentration Performance Data	46
5.27	Bruce Heavy Water Plant - Process Effluent: MISA Concentration Performance Data	48
5.28	Bruce Heavy Water Plant - Process Effluent: Post MISA Monitoring Concentration Performance Data	49
5.29	Proposed Sulphide Limits for Process Effluent (0500) and Process Effluent Lagoon Effluent (0400)	49
5.30	Bruce Heavy Water Plant - Process Lagoon Effluent: Concentration Data June 1/90 to March 20/94	50
5.31	Instances of Non-compliance with Proposed Sulphide Limits for Process Effluent - Control Point 0500	50
5.32	Sewage Treatment Plant Concentration Performance Data	55
5.33	Ministry Policies for Operation of Sewage Treatment Plants	56
5.34	Darlington Sewage Treatment Plant	57
5.35	Estimated Loading Removal Summary (kg/year) for Fossil Stations	59
5.36	Estimated Loading Removal Summary (kg/year) for Nuclear Stations	60
5.37	US EPA New Source Performance Standards	61
5.38	US EPA Best Available Technology Standards	62
5.39	Environment Canda Codes of Practice Recommended Effluent Quality	64

5.0 Development of Effluent Limits for the Electric Power Generation Sector

Effluent limits for the Ontario Electric Power Generation Sector (EPGS) were developed by a Limit Setting Subcommittee (LSS) comprised of representatives of Ontario Hydro and the MOEE.

The LSS had the following tasks:

- to define the form of limits (ie. production based loading, average loading or concentration),
- to select a basis for the effluent limits (ie. selection of BAT and performance data),
- to identify the process effluent streams and parameters to be limited,
- to identify the effluent streams for assessment monitoring,
- to select the time basis for limits (ie. daily maximum, monthly average),
- to select the monitoring frequency for limited and assessment parameters,
- to derive numerical limits based on the selected Best Available Technology (BAT) and the evaluation of the data base.

The limits developed by the LSS were presented to the Joint Technical Committee (JTC) for final consensus and approval.

5.1 The Form of Effluent Limits

The Report of the Issue Resolution Committee on Limit Setting and Form of Limits[1,2] recommended three methods for setting effluent limits:

- Method 1: Linear Method (limits are expressed as production based loading limits ie. kg./kw-hrs)
- Method 2: Average Loading Method (limits are expressed as a maximum loading and monthly average kg/day)
- Method 3: Average Concentration Method (limits are expressed as a maximum concentration and monthly average mg/L)

Each of the above recommended methods for limit setting was reviewed as to its applicability to the Electric Power Generation Sector. Development of loading limits was reviewed first; however, effluent limits finally applied to the EPGS are expressed as maximum daily and monthly average concentrations (ie. mg/L - method 3). The rationale for applying concentration limits rather than loading limits (ie. methods 1 or 2) is discussed in the following sections.

5.1.1 Method 1: Linear Method (production based)

This method calculates limits on the basis of production and wastewater flow. Limits are calculated in terms of kilograms of contaminant per kilogram of product where flow per unit of production and effluent concentration are determined from the BAT plants. Use of this form of limit implies that there is a relationship between production and wastewater flow and between production and wastewater contaminant loading.

To determine if production based loading limits could be applied to the EPGS, available data were reviewed to ascertain if there is a good correlation between effluent loading and power production and between effluent flow and power production.

Fossil Stations

Fossil fired stations were evaluated first because it was suspected that if a good correlation as described above, exists, then it would probably be observed at fossil stations[3].

Regression analysis was used to determine if there is a good correlation between monthly average daily loadings of total suspended solids (TSS) and monthly power generation and between monthly average daily flow and monthly power generation for data collected during the MISA monitoring period. Data were analyzed for two streams; ash transport water treatment system (ATWTS) effluent and neutralization sump effluent. These streams are associated with the operation of the boiler and most of the contaminants discharged in these streams from fossil stations are in the form of suspended solids. In particular, the ATWTS discharges the highest flow and carries the highest particulate load of all process effluent; therefore, this stream appears to be a good indicator of the total station contaminant loading.

Ash Transport Water Treatment System Effluent - Fossil Stations

It may appear reasonable to expect that the quantity of ash produced in a fossil generation unit boiler furnace is

proportional to the quantity of coal burned and the corresponding power generated. The relationship between ash production and power production may vary with boiler efficiency and the type of coal burned but nevertheless a trend should exist in each case; however, regression plots provided in Appendix D (pgs. D1 to D5) show a poor correlation between flow and power production and between TSS loading and power production for ATWTS effluent as suggested by reviewing the correlation coefficient "r". The reason for the poor correlation shown is that the total ash produced is not proportional to the amount of ash discharged to the environment in the aqueous wastewater phase. It is the treatment process of the ATWTS that characterizes the ash loading contained in the final effluent stream. For operations and control reasons, ash sluicing intervals and duration are not directly related to power generated (MWH) and the volume of water used to sluice bottom ash is not always dependant on the amount of ash sluiced. Overall, the effect of the ATWTS is not the removal of a set percentage of ash in the influent but the removal of ash to a relatively low concentrations in the effluent regardless of influent concentrations. Consequently there is a poor correlation between contaminant loading in the ATWTS effluent and corresponding power generation.

Neutralization Sump - Fossil Stations

Regression plots provided in Appendix D (pgs. D6 - D10) show a poor correlation between monthly average daily flow and power production and between TSS loading and power production for neutralization sump effluent. The primary factor determining the amount water treatment plant waste is the quantity of demineralized water produced. Demineralized water production is not proportional to power generated; therefore, the quantity of WTP waste is not proportional to power production. It should be noted that a demineralized water inventory is maintained at all stations in large storage tanks.

Boiler blowdown is a primary consumer of demineralized water. The volume of boiler blowdown is dependant on the number of boiler start-ups and the station boiler water chemistry during normal station operation and each site's operating practice.

During boiler start-ups, blowdown is used to control the level of water in the steam drum. Due to the dynamic nature of the demand for fossil generated power, the number of start-ups required by a unit cannot be predicted; therefore, the number of start-ups can vary in producing the same amount of power. A station could run at a low generation level for a continuous time interval with one start up but the same station could be run at higher generation levels for shorter periods for the same time interval. More start-ups will cause a corresponding increase in

boiler blowdown flow.

During normal operation blowdown is used to control the levels of impurities that build up over time of station operation. Boiler chemistry is dictated by the quality of boiler feed water and reactions with boiler tube material. The quantity of blowdown necessary to control boiler chemistry may differ from station to station and boiler to boiler within a station and is therefore poorly related to the quantity of power produced.

Nuclear Stations

At nuclear stations too, there is a poor correlation between power production and effluent contaminant loading because many effluent streams continue to discharge when power production is interrupted. Figures 1 to 12 in Appendix D provide plots of effluent TSS loadings versus power production and effluent volume versus power production for neutralization sump effluent and radioactive liquid waste management system effluent. The data scatter plot on power production and effluent flow/TSS loadings at nuclear stations over the MISA monitoring period support the expected poor correlation between power production and contaminant loadings and between power production and effluent flow.

5.1.2 Method 2: Average Loading Method

The use of this method for setting effluent limits requires the identification of a BAT contaminant loading performance which can be applied to each station. Establishing a BAT loading which is equitable between stations of different sizes also implies that effluent flow and/or contaminant loading is proportional to the size or capacity of each station. A comparison of wastewater flow data from ATWTS and neutralization sumps with fossil station capacity and annual power production is tabulated in Table 1 of the appendix to this section.

Ash Transport Water Treatment System Effluent - Fossil Stations

As discussed under method 1, the amount of ash discharged to the environment is not proportional to the amount of ash sluiced from boiler bottom ash hoppers upstream of the ATWTS. Ash sluicing water volumes are also not proportional to the amount of power produced although they may be proportional to the number of units in operation. The difficulty in comparing ATWTS flow volumes from large and small stations is the differences in the design of ATWTS between stations and wastewaters treated (see Table 5.1).

Table 5.1
Fossil Station - Ash Transport Water Treatment Systems

ATWTS Description	Fossil Station
Bottom Ash Sluicing/Lagoon & Filtration Plant	Lakeview and Lambton
Bottom Ash and Fly Ash Sluicing/Lagoon	Nanticoke
Bottom Ash Sluicing/Ash Quench/Boiler Seal/Coal Pile Runoff/Clarifier	Thunder Bay
Submerged Scraper Conveyor/Ash Quench/Boiler Seal/Clarifier	Atikokan

Only Lakeview and Lambton have comparable systems. Thunder Bay and Atikokan can also be compared since both systems treat approximately the same streams (ie. ash quench/boiler seal water overflow, Thunder Bay treats coal pile runoff as well). The ATWTS effluent flow data summarized in Table 1 of the Appendix to this section, shows a poor correlation with either station capacity or average daily power production.

Neutralization Sump Effluent - Fossil Stations

Although the production of demineralized water is not dependant on the amount of power produced it should be dependant on the number of units operating. Contrary to this expectation, a comparison of flow data from neutralization sumps with fossil station capacity and annual production tabulated in Table 1 of the Appendix to this section indicates that the amount of WTP plant effluent via the neutralization sump is not proportional to capacity or annual average daily power production. One factor contributing to the poor correlation is the type of operation (ie. base load versus peaking) which may affect discharge flow volumes of WTP neutralization sump effluent streams. Fossil stations such as Lakeview generally operate as "peaking" stations.

Nuclear Stations

Radioactive liquid waste management system and neutralization sump flow data for each nuclear station are also summarized in Table 1 of Appendix to this section. As with fossil stations, a poor correlation can be observed between effluent flow and either station capacity or annual daily average power production.

5.1.3 Method 3: Average Concentration Method

Due to the difficulties in setting loading limits according to methods 1 and 2, the limits setting subcommittee recommended that concentration based limits be developed for the EPGS using the average concentration method. Internationally, including the US (EPA), and in Canada (Codes of Practice), the quality standards of effluent from this sector have been specified using effluent concentration of contaminants.

Development of contaminant loading limits is further complicated because boiler ash quench and seal water effluents were not monitored at three fossil stations. Effluent limits are necessary for these streams because they contribute the highest estimated untreated TSS loading from effluent in the Electric Power Generation Sector. Concentration limits will serve as an appropriate basis for limiting these streams. The contaminants in the boiler ash quench and seal water streams are expected to be similar to the influent to the ATWTS. Accurate flows for loading calculations are not available and estimated flows are used in loading reduction estimation.

5.1.4 Selection of the Form of Limits for the EPGS

Based on the discussion and rationale developed in the last three sections, the Limit Setting Subcommittee proposed using concentration based limits in the EPGS Regulation with requirements to report calculated loadings of the limited parameters. The proposal was accepted at the Joint Technical Committee and by MOEE senior management.

5.2 Best Available Technology (BAT) Basis for Effluent Limits

Effluent streams and parameters for which effluent limits can be developed are those which can be controlled by the selected Best Available Technology (BAT).

BAT for the Fossil Subcategory

As discussed under section 4, the economic assessment of the costs of BAT installation and the predicted loading reductions ranked BAT option IA - Treatment of ash quench/boiler seal water as the least cost option on which to base effluent limits for the fossil stations subcategory. Performance data collected during MISA monitoring are available for use in setting concentration limits under this BAT option; therefore, the LSS agreed that development of effluent limits for fossil stations proceed using

the IA-option as the primary basis for effluent quality achievable.

BAT for the Nuclear Subcategory

The economic assessment of the costs of BAT installation and predicted loading reductions ranks the Environment Canada Codes of Practice Option as the most cost effective option on which to base effluent limits for Bruce-A, Bruce-B and Darlington nuclear generating stations. The Partial Reduction of Toxic Streams Option ranked as the most cost effective option for Pickering nuclear generating station; however, as discussed in section 4, a review of effluent data from Pickering NGS indicates that the high flows from building effluent streams bias the selection of the most cost effective option at this station.

With the exception of RLWMS effluent, performance data are unavailable to develop limits for any effluents under the Partial Reduction of Toxic Streams Option. Only partial reuse of wastewaters result from implementation of this option, the quantity of recycle depending on the stations daily water balance. Furthermore, as discussed in section 4, boiler blowdown may not be totally recycled as prescribed under the Partial Reduction of Toxic Streams or Minimum Discharge Options because of possible radiation build-up concerns for station personnel.

Performance data are available to set effluent limits under the Environment Canada Codes of Practice Option. The effluent qualities recommended by the Codes of Practice are based on treatability tests on various power plants effluents (page E-200)[4]. Also, where current effluent contaminant levels, as measured during MISA monitoring period are available for use in setting limits under this option. The performance of alkali precipitation and filtration technology which forms the basis of metals and TSS limits under the Codes of Practice option are also supported by achievable maximum thirty day average effluent qualities provided in the Bechtel Inc. BAT Report (page 4-28)[5].

The LSS agreed that development of effluent limits for all nuclear stations proceed using the Environment Canada Codes of Practice Option as the primary basis for determining the effluent quality attainable.

Nuclear Support Facilities

BAT selected for nuclear support facilities is discussed under the limits development for each site beginning at section 5.7.

5.3 Effluent Streams and Parameters to be Limited

The IRC Report[1] states that limits should be set on a short list of easy to measure toxic and conventional parameters This approach assumes that compliance with the requirements of a select short list will allow control of a longer list of related parameters of concern.

The list of parameters for limits was developed according to the following process:

- preliminary selection of parameters from the sector monitoring data base
- QA/QC Assessment of candidate parameters
- assessment of BAT for the QA/QC validated parameters
- assessment of candidate parameters for possible surrogates
- assessment of "special" parameters

5.3.1 - Preliminary Selection of Candidate Parameters for Limits

In order to prepare a preliminary list of parameters to be assessed as candidates for effluent limits, the procedure described in the IRC Report on Selection of Parameters for Limits[1] was used. Parameters were deleted from consideration for effluent limits if the analysis of effluent monitoring data showed that 90% of the data were detected at a concentration less than the Regulation Method Detection Limit (RMDL) at a 95% confidence level. Parameters remaining formed a list of substances detected at a frequency which was considered great enough to warrant consideration for limit setting.

The application of the above rule to each effluent monitored at each site produced a list of parameters as shown in Tables 5.2 to 5.9. Parameters found in ash quench/ boiler seal water are not included in this table because these effluents were not monitored during the MISA period. A limited quantity of TSS data collected after the MISA period showed typical concentrations of 40 mg/L[6].

In addition to the following tabulated lists of parameters which were found during MISA monitoring, any chemicals known to be used on-site with the potential to enter an effluent stream were assessed as candidates for possible limits. Also, the presence of any parameters of particular environmental concern (ie. those listed for ban or phase-out)[7] were considered for effluent limits.

Table 5.2
Preliminary Selection of Candidate Parameters for Effluent Limits
Fossil Stations: Ash Transport Water Treatment System Effluent

ATG	Parameter	Atikokan AT 0200	Lakeview AT 0200	Lambton AT 0800	Nanticoke AT 0100	Nanticoke PR 0300	Thunder Bay AT 0200
1	COD	•					•
2	Cyanide Total		•				
3	Hydrogen ion (Ph)		•				
4a	Ammonia plus Ammonium	•			•	•	
	Total Kjeldahl nitrogen	•	•		•	•	•
4b	Nitrate + Nitrite		•	•	•	•	
5a	DOC	•	•	•	•	•	•
5b	TOC	•					•
6	Total phosphorus	•	•	•		•	•
7	Specific conductance	•	•	•	•	•	•
8	Total suspended solids	•	•	•	•	•	•
9	Aluminum	•	•	•	•	•	•
	Boron	•	•	•	•	•	•
	Cadmium	•	•	•	•	•	•
	Chromium				•		•
	Copper	•	•	•	•	•	•
	Lithium		•		•		
	Molybdenum	•			•		
	Nickel	•					•
	Strontium	•	•	•	•	•	•
	Vanadium				•		
	Zinc	•	•	•		•	•
9a	Iron, Unfiltered Total	•	•	•	•	•	•
10	Antimony				•		
	Arsenic		•				
	Selenium				•		
11	Chromium (hexavalent)	•					
12	Mercury	•					•
14	Phenolics (4AAP)	•			•		•
16	Bromodichloromethane		•				
	Chloroform		•				•
	Methylene chloride	•					•
	Trichlorofluoromethane			•			
17	Toluene						•
25	Oil and grease	•		•	•	•	•

"•" = Found parameter pH shown as found only if outside the 6.0 to 9.5 range

Table 5.3
Preliminary Selection of Candidate Parameters for Effluent Limits
Fossil Stations: Coal Pile Effluent

ATG	Parameter	Atikokan CP 0400	Lakeview CP 1800	Lambton CP 1100
1	COD		•	
3	Hydrogen ion (pH)		•	
4a	Ammonia plus Ammonium	•	•	
	Total Kjeldahl nitrogen	•	•	
4b	Nitrate + Nitrite		•	
5a	DOC	•	•	•
5b	TOC	•		
6	Total phosphorus	•		•
7	Specific conductance	•	•	•
8	Total suspended solids	•	•	•
9	Aluminum	•	•	•
	Boron	•	•	•
	Cadmium	•	•	
	Copper	•	•	•
	Lithium		•	•
	Molybdenum		•	•
	Nickel	•	•	
	Strontium	•	•	•
	Zinc	•	•	•
9a	Iron, Unfiltered Total	•	•	•
11	Chromium (hexavalent)	•		
12	Mercury			•
14	Phenolics (4AAP)	•		
25	Oil and grease	•	•	•

"•" = Found parameter pH shown as found only if outside the 6.0 to 9.5 range

Table 5.4
Preliminary Selection of Candidate Parameters for Effluent Limits
Fossil Stations: WTP Neutralization Sump Effluent

ATG	Parameter	Atikokan NS 0800	Lennox NS 2300	Thunder Bay NS 1500
1	COD	•	•	•
3	Hydrogen ion (pH)	•		•
4a	Ammonia plus Ammonium	•	•	•
	Total Kjeldahl nitrogen	•	•	•
4b	Nitrate + Nitrite	•	•	•
5	DOC	•	•	•
5	TOC	•	•	•
6	Total phosphorus	•	•	•
7	Specific conductance	•	•	•
8	Total suspended solids	•	•	•
9	Aluminum	•	•	•
	Boron	•	•	•
	Cadmium	•	•	•
	Chromium	•		•
	Copper	•	•	•
	Lead	•		•
	Molybdenum	•		•
	Nickel	•		•
	Strontium	•	•	•
	Zinc	•	•	•
9a	Iron, Unfiltered Total	•	•	•
12	Mercury	•	•	•
14	Phenolics (4AAP)	•	•	•
15	Sulphide		•	
16	Chloroform	•	•	•
25	Oil and grease	•	•	•

WTP = Water treatment plant, "•" = Found parameter, pH shown as found only if outside the 6.0 to 9.5 range

Table 5.5
Preliminary Selection of Candidate Parameters for Effluent Limits
Fossil Stations: Oily Water Separator Effluent

ATG	Parameter	Atikokan OW 0600	Lakeview OW 2300	Lakeview OW 2400	Lennox OW 0300	Thunder Bay OW 1100
1	COD	•	•	•	•	•
3	Hydrogen ion (pH)					
4	Ammonia + Ammonium	•				
	Total Kjeldahl nitrogen	•			•	•
4	Nitrate + Nitrite			•	•	•
5	DOC	•	•	•	•	•
5	TOC	•	•	•	•	•
6	Total phosphorus	•	•		•	
7	Specific conductance	•	•	•	•	•
8	Total suspended solids		•	•		•
9	Aluminum	•	•	•	•	•
	Cadmium		•	•	•	
	Copper		•	•	•	•
	Molybdenum					•
	Nickel	•				
	Strontium	•	•	•	•	•
	Zinc		•	•	•	•
9a	Iron, Unfiltered Total	•	•	•	•	•
14	Phenolics (4AAP)	•	•	•		•
16	1,1-Dichloroethane		•	•		
	Chloroform		•	•		•
	Methylene chloride	•				•
	Trichlorofluoromethane	•				
	Bis(2-ethylhexyl) phthalate		•			
25	Oil and grease	•	•	•	•	•
27	PCBT			•		

"•" = Found parameter, pH shown as found only if outside the 6.0 to 9.5 range

Table 5.6
Preliminary Selection of Candidate Parameters for Effluent Limits
Nuclear Stations: Radioactive Liquid Waste Management System Effluent

ATG	Parameter	Bruce-A RL 0100	Bruce-B RL 0100	Darlington RL 0100	Pickering RL 0200	Pickering RL 3700
1	COD	•	•	•	•	
3	Hydrogen ion (pH)	•	•			
4a	Ammonia plus Ammonium	•	•	•	•	
	Total Kjeldahl nitrogen	•	•	•	•	•
4b	Nitrate + Nitrite	•			•	
5a	DOC	•	•	•	•	•
5b	TOC	•	•	•	•	•
6	Total phosphorus	•	•	•	•	•
7	Specific conductance	•	•	•	•	•
8	Total suspended solids	•	•	•	•	
9	Aluminum	•	•	•	•	•
	Boron	•	•			
	Cadmium	•		•	•	
	Copper	•	•	•	•	•
	Lithium	•		•	•	
	Molybdenum		•			
	Nickel				•	
	Strontium	•	•	•	•	
	Zinc	•	•	•	•	•
9a	Iron, Unfiltered Total	•	•	•	•	•
12	Mercury	•	•			
14	Phenolics (4AAP)	•		•		
15	Sulphide	•				
16	1,4-Dichlorobenzene			•		
	Chloroform	•	•	•	•	
	Methylene chloride	•	•		•	
	Tetrachloroethylene	•				
17	m-Xylene and p-Xylene			•		
	o-Xylene			•		
19	Benzylbutylphthalate			•		
	Bis(2-ethylhexyl) phthalate	•	•	•		
23	1,2,3-Trichlorobenzene			•		
	1,2,4-Trichlorobenzene			•		
24	Octachlorodibenzo-p-dioxin			•	•	
25	Oil and grease	•	•	•	•	•
27	PCBT	•			•	•

"•" = Found parameter, pH shown as found only if outside the 6.0 to 9.5 range

Table 5.7
Preliminary Selection of Candidate Parameters for Effluent Limits
Nuclear Stations: WTP Neutralization Sump Effluent

ATG	Parameter	Bruce-A NS 1400	Bruce-B NS 2000	Darlington NS 2200	Darlington NS 1100	Pickering NS 3100
1	COD	•	•	•	•	
2	Cyanide Total			•		
3	Hydrogen ion (pH)	•		•	•	•
4a	Ammonia plus Ammonium			•		•
	Total Kjeldahl nitrogen	•	•	•	•	•
4b	Nitrate + Nitrite	•	•	•	•	•
5a	DOC	•	•	•	•	•
5b	TOC		•	•		•
6	Total phosphorus	•	•			
7	Specific conductance	•	•	•	•	•
8	Total suspended solids		•		•	•
9	Aluminum	•	•	•	•	•
	Boron	•	•	•		•
	Cadmium	•	•	•	•	•
	Chromium		•			
	Copper	•	•	•	•	•
	Lithium			•		
	Molybdenum	•	•	•		
	Nickel	•		•		•
	Strontium	•	•	•	•	•
	Zinc	•	•	•	•	•
9a	Iron, Unfiltered Total	•	•	•	•	•
12	Mercury	•		•	•	
14	Phenolics (4AAP)			•	•	
16	Bromodichloromethane	•	•	•	•	
	Chloroform	•	•	•	•	
	Dibromochloromethane	•	•		•	
25	Oil and grease		•			•

"•" = Found parameter, pH shown as found only if outside the 6.0 to 9.5 range

Table 5.8
Preliminary Selection of Candidate Parameters for Effluent Limits
Nuclear Stations: Oily Water Separator Effluent

ATG	Parameter	Darlington OW 1900	Pickering OW 2700	Pickering OW 3600
1	COD	•		
2	Cyanide Total	•		
3	Hydrogen ion (pH)			•
4a	Ammonia plus Ammonium	•		
	Total Kjeldahl nitrogen	•		•
5a	DOC	•	•	•
5b	TOC	•		
6	Total phosphorus	•		
7	Specific conductance	•	•	•
8	Total suspended solids	•		
9	Aluminum	•	•	•
	Cadmium	•		
	Copper	•		
	Strontium	•	•	•
	Zinc	•	•	•
9a	Iron, Unfiltered Total	•	•	•
14	Phenolics (4AAP)	•	•	
16	Methylene chloride			•
25	Oil and grease	•	•	•

"•" = Found parameter, pH shown as found only if outside the 6.0 to 9.5 range

Table 5.9
Preliminary Selection of Candidate Parameters for Effluent Limits
Nuclear Associated Facilities Process Effluent Streams

ATG	Parameter	Darlington Construction PR 0800	Bruce Heavy Water Plant PR 0400	Bruce Heavy Water Plant PR 0500	BNPD Services PR 0100	BNPD Services PR 0200	BNPD Services PR 0300	BNPD Services PR 0400
1	COD	•	•		•	•		
2	Cyanide Total	•						
3	pH, Average Daily	•		•	•			
4a	Ammonia plus Ammonium	•			•			
	Total Kjeldahl nitrogen	•	•		•	•	•	•
4b	Nitrate + Nitrite	•	•	•	•	•	•	•
5a	DOC	•	•	•	•	•	•	•
5b	TOC	•	•			•		
6	Total phosphorus	•			•			
7	Specific conductance	•	•	•	•	•	•	•
8	Total suspended solids	•	•		•		•	•
9	Aluminum	•	•	•	•	•	•	•
	Boron				•			
	Cadmium	•						
	Copper	•			•	•	•	•
	Strontium	•	•	•	•	•	•	•
	Zinc	•	•	•	•	•	•	•
9a	Iron, Unfiltered Total	•	•	•	•	•	•	•
10	Antimony	•						
12	Mercury	•						
14	Phenolics (4AAP)	•		•	•	•	•	•
15	Sulphide			•				
16	Bromodichloromethane	•			•			
	Chloroform	•			•			
	Dibromochloromethane	•						
17	Toluene	•						
19	Bis(2-ethylhexyl) phthalate	•	•					
25	Oil and grease	•	•	•				
31	Total Residual Oxidants	•			•			

"•" = Found parameter, pH shown as found only if outside the 6.0 to 9.5 range

5.3.2 - QA/QC Assessment of Monitoring Data

The validity of all data collected, for each parameter under consideration for limits, was checked by reviewing QA/QC data which was also collected as part of the MISA effluent monitoring regulation. QA/QC data consisted of laboratory blanks, travelling blanks, travelling spiked blanks and duplicate sample analytical results. Details of the assessment of QA/QC data are described in the draft report entitled "Electric Power Generation Sector (EPGS) Draft Data Quality Evaluation Report" dated January 1993[8].

5.3.3 - Assessment of Control Through Selected BAT

All parameter for which reliable data were available were then assessed to determine if effluent limits could be developed. Limits were developed based on the presence or potential presence (ie. chemicals used on-site) of the parameters identified for limits and the identification of BAT control for these parameters, either in-place or which could be successfully retrofitted as prescribed by the BAT option.

With the exception of boiler blowdown and boiler layup, parameters were identified for limits in each process stream at fossil and nuclear generating stations and nuclear associated facilities. Table 5.10 and 5.11 provides a list of all streams and the parameters for each stream advanced for limit setting at fossil stations and nuclear generating stations respectively. Table 5.12 provides the list of all streams and parameters for which effluent limits were developed for the nuclear associated facilities. Only selected streams were limited at these sites. Appendix to this section contains details on the rationale (see Tables A through I) applied to developing these tables.

Limits were not developed for boiler blowdown effluent. The reasons for excluding boiler blowdown from limits are discussed under section 5.3.4. The LSS also agreed to conduct assessment monitoring of building effluent as discussed under section 5.3.5.

Table 5.10
Candidate Parameters for Limits Based on Assessment of BAT Options for Fossil Stations

ATG	Parameter/Effluent	AT	QS	NS	OW	EC	CP
5b	Dissolved Organic Carbon				•		
8	Total Suspended Solids	•	•	•	•	•	•
9	Aluminum	•	•	•			
	Copper	•	•	•			•
	Zinc	•	•	•			
9a	Iron	•	•	•		•	•
25	Oil & Grease				•		

Legend:
ATG - Analytical Test Group
AT - Ash Transport Water
QS - Quench/Seal Water
OW - Oily Water Separator
EC - Equipment Cleaning Effluent
CP - Coal Pile Effluent
NS - Neutralization Sump

Table 5.11
Candidate Parameters for Limits Based on Assessment of BAT Options for Nuclear Stations

ATG	Parameter/Effluent	RL	NS	OW	EC
6	Total Phosphorus	•			
8	Total Suspended Solids	•	•		•
9	Aluminum		•		
	Zinc	•			
9a	Iron	•	•		•
25	Oil and grease	•		•	

Legend:
RL - Radioactive Liquid Waste Management System Effluent
NS - Water Treatment Plant Effluent
OW - Oily Water Separator Effluent
EC - Equipment Cleaning Effluent

Table 5.12
Candidate Parameters for Limits Based on Assessment of BAT Options for Nuclear Associated Facilities

ATG	Parameter/Effluent	Bruce Heavy Water Plant		Bruce Nuclear Power Development Services		Darlington Construction Site	
		PR 0400	PR 0500	PR 0100	EC	EC	PR 0800
1a	BOD_5			●			●
4a	NH3 plus $NH4^+$			●			●
6	Total Phosphorus			●			●
8	TSS			●	●	●	●
9a	Iron				●	●	
15	Sulphide	●	●				
25	Solvent Extractables			●			●

Legend:
PR 0400 - Process Lagoon Effluent
PR 0500 - Process Effluent
PR 0100 - Sewage Treatment Plant Effluent
PR 0800 - Sewage Treatment Plant Effluent
EC XXXX - Equipment Cleaning Effluent

5.3.3.1 Assessment of Candidate Parameters for Possible Surrogates

Fossil Subcategory

The Ministry consultant analyzed the candidate parameters by treatability groups.

Group 1:- Priority 1 (found) metals that can be precipitated by alkaline precipitation and therefore removed as hydroxides are: Aluminum, Boron, Iron, Strontium, Cadmium, Copper, Nickel, Zinc, Lead and Chromium (III).

Aluminum and Iron were detected in the highest concentration in the largest number of streams monitored. Since there is no aluminum guideline in the Environment Canada Codes of Practice, Iron was picked as the key parameter. Iron also serves as a representative for the other metals in group 1.

Copper, Cadmium, Nickel and Zinc are all potentially toxic to aquatic life since Provincial Water Quality Objectives exist for these metals. The following table 5.13 summarizes the stream frequency in which the metals were found and average concentration data for these metals.

Table 5.13
Detection of Copper, Cadmium, Nickel and Zinc in Fossil Subcategory Effluents

Metal	Detection in percentage of streams as Priority 1	Maximum Average Concentration (ug/l)	Average of Average Concentrations (ug/l)
Copper	92%	128,964	1506
Cadmium	49%	334	10
Nickel	22%	71,600	3,740
Zinc	72%	10,210	255

Lead was detected at concentrations (450 ug/l) exceeding five times RMDL (RMDL = 30 ug/l) only once at Nanticoke pre-heater wash, unit 1,2 (control point 2320). This parameter was also dropped from further consideration as this is an up-stream discharge.

Based on toxicity considerations as well as highest frequency of occurrence, copper was selected as a key parameter to represent potentially toxic group of metals.

Group 2:- Priority 1 metals which may require sulphide precipitation : Mercury.

Mercury was detected only twice at levels exceeding five times RMDL (RMDL= 0.1 ug/l). Average concentrations detected at Atikokan WTP Neutralization Sump and at Thunder Bay Neutralization Sump were 2.4 ug/l and 1.99 ug/l respectively. It is not feasible to remove mercury sufficiently to very low concentrations by conventional treatment processes. Therefore, the most effective way to deal with streams containing elevated concentrations of mercury is to eliminate their discharge by source control. Mercury was therefore not considered a key parameter for this sector.

Group 3:- Priority 1 metals likely to exist as anions in solution, and which would not be removed by precipitation treatment except by co-precipitation mechanism: Molybdenum and Chromium (VI).

Molybdenum average concentration exceeded five times the RMDL in direct discharges only in four streams at three facilities, with concentrations ranging from 106 ug/l to 184 ug/l. No demonstrated BAT was identified at these low levels and therefore molybdenum was excluded as a key parameter.

Hexavalent chromium was detected only four times at levels exceeding five times RMDL and only at Nanticoke in upstream equipment cleaning effluent. Therefore, this parameter was dropped from further consideration.

Group 4:- Metals not removable by precipitation: Lithium.

Lithium is not considered to be toxic to humans or the environment, therefore it was dropped from further consideration.

Organic Compounds

No individual organic compounds were selected as key parameters for the fossil stations because:

- Organic compounds were listed as Priority 1 very infrequently
- No consistent pattern in the types of organic compounds detected was apparent, with the exception of chloroform
- Detections were limited to fairly low concentrations - generally less than 10 ug/l.

Organic compounds were not selected as key parameters.

Nuclear Subcategory

The Ministry BAT consultant (AWT/M&E), also reviewed the data base for the nuclear subcategory and, based on a similar analysis, came to the following conclusions:

Key metal parameters were Copper (found in 86% streams), Zinc (95%) and Iron (97%).

Organic parameters were excluded because of very infrequent and low concentrations of detection (< 10 ug/L).

5.3.3.2 Assessment of Special Parameters

Poly-chlorinated Biphenyls (PCB's)

PCB's were found at low levels in process effluent at two nuclear and one fossil station. Daily loadings were very low: average of less than 0.1 gm/day. Table 5.14 summarizes the data for process streams where PCB's were detected.

Table 5.14
Summary of EPGS PCBs (Total) Data - RMDL = 0.1 ug/L

Station	Control Point	# Samples	# Detected	Average Concentration, ug/l	Average Loading, g/day	Maximum Loading, g/day
Lakeview	2400	4	3	0.085	0.001	0.003
Bruce A	0100	51	28	0.17	0.03	0.4
Pickering	0200	50	40	0.257	0.08	0.4

PCBs were also found in storm waters at 9 stations (average concentrations 0.1 - 0.39 ug/L)

PCBs are of particular environmental concern and are listed by the MOEE as a parameter for ban or phaseout. The source of PCBs found in the above effluents is believed to be residual contamination from historical accidental releases (ie. during construction and commissioning of these stations). Contaminated sludge in the bottom of tanks, sumps and drains may be the primary contributors to PCBs in process effluent.

Analysis of PCBs

The accuracy of PCB results collected during MISA monitoring may be questionable. QA/QC results show that all PCB data from Ontario Hydro may be overestimated by 150 to 200%.

Effluent Treatment for PCBs

Treatment for PCBs was not identified under the study for Best Available Technologies. Because the primary source of PCBs is residual contamination the only method of controlling discharge of PCBs appears to be the cleanup of contaminated areas (ie. bottoms of tanks, sumps, drains, soils).

Control of PCBs

Ontario Hydro has already initiated (1988) a PCB phase-out program to:

- remove bulk of PCBs from service
- destroy PCBs by an approved method
- cleanup residual contamination

Planned completion:
- hydraulic 1997
- fossil 2005
- nuclear 2010

In addition, recent (1994) targets have been set under the Canada Ontario Agreement (COA) to decommission 90% of high level PCBs (>1% PCB content) presently in use and destroy 50% of high level PCBs stored by the year 2000.

Based on the above discussion limits are not being set for PCB's in the Electric Power Generation Sector. The reasons are summarized under the following bullets.

- Concentrations of PCBs found in EPGS effluents were very low (at or near detection level).
- The quality of the data collected is questionable (overestimated).
- Technology was not identified for treatment at the low levels found.
- Elimination of PCB contaminated materials will be dealt with through other government strategies.

5.3.4 Exclusion of Boiler Blowdown from the Regulation

Boiler blowdown is currently discharged untreated at all fossil and nuclear generating stations. Although levels of contaminants detected during MISA monitoring were typically low and installation of treatment was not prescribed under the BAT options identified as the most cost effective, toxicity was identified as a major concern with boiler blowdown effluent. Boiler blowdown effluent from all fossil stations were consistently toxic to Daphnia magna and frequently toxic to rainbow trout. Toxicity of boiler blowdown from nuclear stations varied. Boiler blowdown effluent at Pickering was consistently toxic to rainbow trout and Daphnia magna. In contrast, Bruce-B was relatively non-toxic with only one sample testing toxic to Daphnia magna and none lethal to trout. The production of non-toxic effluents is a fundamental requirement of the MISA program; therefore, cost effectiveness is not the sole factor to be considered when selecting streams and parameters for which effluent limits should be developed. Due to concerns with toxicity, a detailed review of the causes and solutions to boiler blowdown toxicity was conducted by Ontario Hydro Research.

Causes of Boiler Blowdown Toxicity[9,10]

MISA analytical data indicate that the toxicity of boiler blowdown effluent is due to combinations of factors including, low ionic strength (ie. low conductivity), pH >9, free ammonia >100 ug/L and in a few instances, elevated levels of copper and zinc; however, levels of contaminants in many of the toxic samples were at levels not normally considered toxic. The major cause for toxicity to trout in these samples was attributed to ionic stress caused by the low dissolved solids content. Daphnia magna were more sensitive to the combination of parameters in boiler blowdown.

Because low conductivity appeared to be a primary contributor to the toxicity of boiler blowdown effluent, Ontario Hydro initiated studies to determine if toxicity could be attributed to the lack of some component in boiler blowdown which is naturally present in lake water. One study[11] identified that toxicity toward rainbow trout could be eliminated by the addition of hardness (calcium) to boiler blowdown, while toxicity toward Daphnia magna was reduced but not eliminated. A second study[12] concluded that toxicity to Daphnia magna could be eliminated by addition of humic acids to natural levels.

Contaminant Sources

Parameters which were found at the highest concentrations in boiler blowdown effluent are those expected to be found as a result of treatment chemicals added and corrosion of boiler construction materials.

Due to differences in design, construction materials, operation and age, boiler treatment practices differ between generating stations. As a result, the concentrations of treatment chemicals in boiler blowdown effluent also differ. Parameters found as a result of boiler water treatment, and also linked to toxicity, include elevated levels of ammonia and pH at all stations from the addition ammonia and/or morpholine.

Boiler water treatment chemicals presently used in the Electric Power Generation Sector are summarized in Table 5.15.

Table 5.15
Summary of Boiler Water Treatment Chemicals Used
in the Electric Power Generation Sector

Boiler Treatment Chemical	Purpose	Fossil Subcategory	Nuclear Subcategory	Associated Facilities
Ammonia	raise pH	all stations	Bruce-B, Darlington	not used
Morpholine	raise pH	not used	Bruce-A, Pickering	Bruce Steam Transformer Plants
Hydrazine	remove oxygen	all stations	all stations	Bruce Steam Transformer Plants
Phosphate	prevent scaling	all stations	not used	not used

Products of corrosion are a function of the construction material of the boiler/feed water systems at each station. Iron was found at elevated levels only at Darlington. At all other stations iron levels were near or below intake water iron levels. Copper and zinc were detected only at very low levels at Bruce-B and Darlington because construction of the boiler systems are all ferrous. Copper, and zinc were found at higher levels at other stations because they contain some brass components.

Most parameters at fossil stations were found at low levels. A summary of average concentrations for all parameters found in boiler blowdown is provided in Appendix B, Table 33.

BAT Treatment for Boiler Blowdown Effluent

A summary of the handling of boiler blowdown effluent as prescribed under each of the BAT option for fossil and nuclear stations is provided in Table 5.16. The AWT/M&E BAT study did not identify treatment for boiler blowdown effluent under the Ash Quench/Boiler Seal Water Treatment Option for fossil stations or the Best in Ontario or the Environment Canada Codes of Practice Options for both fossil and nuclear stations. With the exception of copper levels at Nanticoke and phosphorus at Lambton, levels of contaminants are generally below levels treatable by conventional precipitation technology. Reuse was the only option identified for reducing loadings of contaminants from boiler blowdown and is considered only under the more expensive BAT options (ie. Partial Reduction of Toxic Streams and Minimum or Zero Discharge options).

Effluent limits cannot be set under the Reduction in Toxic Streams Options because performance data are not available. Also, reuse of boiler blowdown at nuclear stations, as specified under

the Partial Reduction of Toxic Streams and Minimum Discharge Options, may increase the tritium content in the steam, condensate and feedwater systems. Because of concerns about a resulting potential increase in radiation dosage to station personnel or to personnel at steam users outside the station, reuse of boiler blowdown cannot be implemented at nuclear stations without further study.

Table 5.16
Summary of BAT Treatment of Boiler Blowdown Effluent

BAT Option		Fate of Boiler Blowdown Effluent Under Each Option
Fossil Subcategory		
IA	Treat Ash Quench & Boiler Seal Water Effluent	Discharged to CCW
I	Best in Ontario	Discharged to CCW
II	Environment Canada Design Codes of Practice	Discharged to CCW
III	No Discharge of Proven Toxic Streams	Approximate 85% reuse
IV	Minimum Discharge without Cooling Tower for Main Condenser Cooling	100% reuse
V	Zero Discharge (Best in Canada)	100% reuse
Nuclear Subcategory		
I	Best in Ontario	Discharged to CCW
II	Environment Canada Design Codes of Practice	Discharged to CCW
III	Partial Reduction of Toxic Process Streams	Approximate 85% reuse **
IV	Minimum Discharge	100% reuse **

** May not be feasible to totally recycle boiler blowdown due to tritium accumulation radiation concerns discussed above.

U.S. E.P.A. Limits on Boiler Blowdown

The US EPA established limits for boiler blowdown effluent given in Table 5.17.

Table 5.17
U.S. EPA Limits for Boiler Blowdown Effluent

Parameter	Concentration Limit	Assessment of Compliance
Total Suspended Solids (TSS)	30 mg/L	30 day average
	100 mg/L	daily maximum
Oil & Grease	15 mg/L	30 day average
	20 mg/L	daily maximum

Note: Permit writers can establish a mass limit on a site specific basis based on the above concentration limits if a representative flow can be determined.

Neither TSS nor oil & grease were found at treatable levels under MISA monitoring. Average concentrations of TSS were less than the regulation method detection limit (5 mg/L) in 91% of boiler blowdown effluent and less than intake concentrations in all boiler blowdown effluent except the temporary boilers at Darlington construction which are now shutdown. The maximum oil and grease concentration measured in boiler blowdown was 8.4 mg/L. Average oil and grease concentrations were less than 2 mg/L in 93% of boiler blowdown effluents.

Based on the detailed review of contaminant loadings and concentration levels, sources and causes for toxicity and BAT identified for control of boiler blowdown effluent, the limit setting subcommittee decided to exclude boiler blowdown from this regulation. The rationale is summarized in the following bullets:

- A primary cause for toxicity of boiler blowdown effluent is attributed to low ion concentration as opposed to high levels of contaminants. Toxicity would be eliminated upon discharge to the condenser cooling water effluent stream prior to the final outfall.

- A method identified by Ontario Hydro for removing toxicity from boiler blowdown effluent is to add humic acids and increase hardness. The logic of using such an approach is questionable when toxicity would be removed upon mixing with the condenser cooling water which contains natural humic acids and hardness.

- Concentrations of most contaminants are typically low.

- Levels of impurities are below sector BAT treatability (ie. lime precipitation and or filtration) prescribed under the most cost effective BAT options.

- Performance data are unavailable with which to predict effluent quality under partial recycle of boiler blowdown prescribed under the Partial Reduction of Toxic Streams BAT Option (III).

- Reuse of boiler blowdown at nuclear stations, as specified under BAT options III and IV, will likely increase the tritium content in the steam, condensate and feedwater systems. Due to concerns about a resulting increase in radiation dosage to station personnel or personnel at steam users outside the station, recovery of boiler blowdown cannot be implemented at nuclear stations without further study.

- The major source of metals appears to be corrosion of feed/steam cycle equipment components which varies with construction materials and station age. Boiler system components are extremely expensive; therefore, corrosion is controlled to the maximum extent practicable by using boiler water treatment chemicals.

- The ammonia in boiler blowdown is added to boiler water to maintain elevated pH. Levels of ammonia are low. Technology has not been identified for treatment of ammonia at these levels. Discharge of such parameters can only be controlled by optimization the quantity of water treatment chemical addition rather than end-of-pipe treatment.

- Boiler treatment practices vary between stations and will change in the future (eg. Bruce-A has applied for approval to use boric acid as a boiler treatment chemical).

5.3.5 Assessment Monitoring of Building Effluent

Building effluent are either low volume streams which contribute a very small proportion of total station loadings or high flow streams which may contribute significant loading but are comprised primarily of once through cooling water.

Building effluent at fossil stations originate from boiler house or the turbine hall drains and are comprised primarily of cooling water. Concentration levels exceeding 25 mg/L for TSS recommended under the Environment Canada Codes of Practice were detected at Lakeview and Nanticoke. These two stations, and Lambton, currently direct untreated ash quench/ boiler seal water to the building effluent. The effluent limits regulation specifies effluent limits for ash quench/boiler seal water streams; therefore, once ash quench/ boiler seal discharges are directed to treatment a primary source of TSS found in building effluent will have been removed. Refer to Appendix B, Table 34

Treatment of building effluent is not prescribed under the Environment Canada Codes of Practice Option at nuclear stations because levels of contaminants found are typically below the effluent qualities recommended under the Codes of Practice. Some samples at Darlington NGS showed elevated levels of oil & grease and iron; however, these streams are very low in volume compared to building effluent at other facilities. Refer to Appendix B, Table 34 and 36.

The LSS, drawing on the parallel for assessment monitoring for cooling water in other sector regulations, recommended that building effluent be monitored for assessment. The assessment data will supplement the data which was collected during the MISA monitoring period and may be used to develop control programs to ensure that building effluent are free of contaminants of concern and are non-toxic.

The Limit Setting Subcommittee agreed that monitoring of total suspended solids and oil & grease was appropriate due to the potential of leaks of oil and/or ash to these streams. Because of the large number of discharge points (28 for fossil subcategory and 48 for nuclear subcategory) and corresponding high costs associated with monitoring (particularly toxicity testing), only quarterly assessment monitoring requirements are prescribed along with quarterly toxicity testing.

The rationale for assessment monitoring of building effluent is summarized under the following bullets:

- the MISA Program requires discharge of nonlethal effluent,
- very limited monthly monitoring information was collected on these streams (once per month),
- no lethality data was collected during the monitoring period.

A summary of average concentrations for all parameters found in building effluent is contained in Appendix B.

5.4 Effluent Limit Setting

Effluent limits for most process effluent streams were derived from effluent data collected during the MISA monitoring period according to the statistical procedure outlined in the Issues Resolution Committee Report on Monitoring Data Analysis and Limit Setting and Form of Limits[1]. Concentration limits (daily maximum and monthly average) were developed for all process effluent streams where BAT control was currently available for controlling a parameter. The limits regulation also contains the generic requirement for control of pH between the range 6.0 to 9.5 on all process effluent streams and the requirement for all effluent streams to be nonlethal to rainbow trout and Daphnia magna.

5.4.1 Statistical Analysis of MISA Monitoring Data

The key steps followed during the statistical data analysis were:

- Data editing of "less than detection level" results
- Estimation of long term average (LTA) concentration
- Variability Analysis
- Statistical outliers analysis
- Setting of performance values

Data Editing

The following rules were applied to parameters reported less than detection level (< DL)

- If the result reported was less than the Laboratory Method Detection Limit (LMDL) and greater than 1/10 RMDL then the value was used as reported.

- If the result that was reported was less than or equal to 1/10 RMDL then the value was replaced by 1/10 RMDL.

Estimation of Long Term Average Concentration

The long term average concentration is the arithmetic mean of all data collected for a parameter from a plant's effluent stream. Effluent quality of all similar streams in a subsector should meet the long term average effluent quality as determined from the BAT plants. The long term average itself could serve as a limit provided that the assessment of compliance took place over a similar number of samples (ie. 365 if sampled daily). To allow assessment of compliance on a more frequent basis (ie. monthly or daily) a variability component must be included to account for the impact of short term variability. Sources of variability include those that are associated with treatment processes, production processes and sampling and analytical methods.

Variability Analysis

Effluent limits are derived from MISA monitoring data by applying variability factors to the long term average concentrations calculated for each parameter. Daily maximum and monthly average effluent limits were calculated as the product of the long term average (LTA) concentration and the daily and monthly variability factors (VFs). The daily VF is the ratio of the 99th percentile concentration from the statistical

distribution of daily samples to the LTA. The monthly VF is based on the 95th percentile concentration from the statistical distribution of monthly average samples. Monthly average variability factors are calculated from 30 day means (VF30) of data for parameters sampled daily or from 4 day means (VF4) of data for parameters sampled weekly.

Summaries of the variability analysis used to derive effluent limits from MISA monitoring data according to the above procedure are presented along with an explanation for the final limit numbers agreed upon by the Limit Setting Subcommittee (LSS) under section 5.5 for fossil stations, 5.6 for nuclear stations and 5.7 for the nuclear associated facilities. An explanation of the abbreviations used in the effluent performance data tables that follow is provided in Table 5.18.

Table 5.18
Legend for Abbreviations Used in Tables of Effluent Performance

Abbreviations	Description
TGS	Thermal Generating Station
CtrlPt	Control Point
AT	Ash Transport Water Treatment System Effluent
OW	Oily Water Separator Effluent
CP	Coal Pile Effluent
NS	Neutralization Sump Effluent (Water treatment plant effluent)
RL	Radioactive Liquid Waste Management System Effluent
N	Number of Samples Analyzed
LTA	Long Term Average Concentration
VF1	Daily Variability Factor
VF4	Monthly Average Variability Factor Based on Weekly Sampling (ie. four samples per month)
VF30	Monthly Average Variability Factor Based on Daily Sampling (ie. thirty samples per month)
DAYLIM	Maximum Daily Concentration (LTA x VF1)
M4LIM	Maximum Monthly Average Concentration - Weekly Sampling (LTA x VF4)
M30LIM	Maximum Monthly Average Concentration - Daily Sampling (LTA x VF30)

Statistical Outlier's Analysis

Extreme or outlier values may occur as a result of plant upsets, QA/QC problems, sampling errors or unknown causes. These values may be non-representative of normal station operation and were therefore considered for exclusion from the data used for

setting effluent limits; however, all statistical outliers were ultimately included in the data from which effluent limits were derived because the values could not be ascertained as being non-representative of normal station operation.

5.5 Effluent Limits for the Fossil Station Subcategory

In Section 5.2, the BAT option selected as the basis for developing effluent limits for the fossil station subcategory was BAT Option IA: Treatment of Ash Quench/Boiler Seal Water effluent. Limits derived for quench/seal waters at the three stations which do not currently provide treatment for these streams (Lakeview, Lambton and Nanticoke) are based on the additional treatment prescribed under this option. Effluent limits for other process effluent streams are based on the performance of existing treatment systems.

5.5.1 Ash Quench / Boiler Seal Water Effluent

BAT Option IA: Treatment of Ash Quench/Boiler Seal Water entails providing treatment for quench/seal water effluent at the three fossil stations which do not currently treat these wastewaters. It was agreed by the BAT subcommittee that quench/seal water could be directed to the existing ash transport water treatment systems (ATWTS) or additional treatment installed to meet the current effluent quality of the existing ash transport water treatment systems; therefore, limits developed for ash quench/boiler seal water are identical to the limits developed for ATWTS effluent discussed below.

5.5.2 Ash Transport Water Treatment System Effluent (ATWTS):

Effluent limits for the ATWTS are based on the effluent quality achieved by these treatment systems during the MISA monitoring period. Table 5.19 lists the concentration performance data for the ATWTS effluents for the parameters identified for limits: Total Suspended Solids, iron and aluminum.

TSS Limits

The monthly average limit for TSS of 25 mg/L in effluent from ATWTS is based on the monitored performance of the ATWTS filtration plant at Lakeview. The performance of the system at Lakeview was used as the basis to limit ATWTS effluent because all coal fired stations except Nanticoke use filtration to remove

suspended solids prior to discharge. MISA performance data from Lakeview suggest a monthly M30LIM of 26.6 mg/L whereas data from other filtration plants suggest monthly average TSS limits ranging from 16.4 to 18.7 mg/L. The ash quench/ boiler seal BAT option does not include costs to reduce TSS levels at Lakeview to the 17 - 18 mg/L level achieved by the ATWTS at other stations; however, Ontario Hydro agreed that Lakeview could control process variability to meet a monthly average TSS limit of 25 mg/L based on daily sampling.

Daily limits for TSS of 70.0 mg/L are based on the average MISA performance data (66.9 mg/L) for ATWTS effluent at all stations except Nanticoke. The LSS agreed that the daily limits suggested by performance data for Lakeview and Lambton (92 and 75 mg/L respectively, refer Table 5.19) are influenced by a few high concentration values (outliers). Ontario Hydro agreed to a daily TSS limit based on the average performance of all filtration plants because TSS data collected from Lakeview after MISA monitoring indicate that process variability has improved.

Effluent data for Nanticoke was excluded when calculating the average performance capabilities of ATWTS because during the 1992/1993 period, Nanticoke's wet fly ash handling system was changed to a dry fly ash handling system similar to systems at the other fossil stations. Therefore, the monitoring data collected for Nanticoke are not representative of the current (post MISA monitoring, see footnote Table I, Appendix B) ATWTS performance at this station.

Iron Limits

ATWTS effluent performance (0.996 mg/L, see Table 5.19) for Thunder Bay TGS was used as the basis for the monthly average iron limits of 1.0 mg/L. Although this station showed the highest levels of iron, Ontario Hydro argued that iron levels were variable, dependant on the quality of coal; therefore, the concentrations of iron found at each station may not be truly representative of treatment performance. The 1 mg/L monthly average limit for iron derived from the effluent quality at Thunder Bay is also supported by the 1.0 mg/L effluent quality for iron recommended under the Environment Canada Codes of Practice. The daily maximum limit of 2.5 mg/L was also set based on Thunder Bay performance (DAYLIM = 2.44 mg/L).

Aluminum Limits

Aluminum is limited because of it's presence in coal ash (12% typical) and also because aluminum based water treatment

chemicals are used at one of the fossil stations. All five coal fired stations direct some WTP waste to the ATWTS for co-treatment. Ontario Hydro argued that aluminum levels in ATWTS effluent were dependant on type of coal and intake levels and furthermore, BAT was not identified for reduction in levels of aluminum. To insure no back-sliding on the discharge concentration of WTP chemicals, limits for aluminum are based on the highest levels found in ATWTS effluent during MISA monitoring from the five directly discharged ATWTS effluents. The monthly average limit of 4.5 mg/L is based on the performance at Atikokan whereas the daily limit of 13.0 mg/L is based on daily performance at Lambton. In cases where water treatment plants discharge waste independently of the ATWTS, the LSS agreed that aluminum limits will only apply where aluminum containing water treatment chemicals are employed - [eg. alum: $(Al_2(SO_4)_3]$.

Limits based on daily sampling will be used to assess compliance with TSS levels because:

- the major contaminant released in effluents from coal fired stations is suspended solids (ash)
- the ATWTS carries the bulk of the TSS loading emitted from fossil stations
- TSS is a principal control parameter for operation of the ATWTS
- daily sampling is required to ensure calculation of a representative loading to the environment

Limits and assessment of compliance for iron and aluminum levels are based on weekly sampling as agreed by the LSS.

Copper and zinc were excluded from limits because the concentrations (copper less than 17 ug/l; zinc less than 74 ug/l) found in ATWTS effluent during MISA monitoring are below BAT treatable levels and also because limits on Total Suspended Solids and iron (as discussed earlier) will serve to indirectly control the discharge of all heavy metals.

Table 5.19
Ash Transport Water Treatment System Effluent
Concentration Performance Data -- All Data

Total suspended solids (TSS), mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Atikokan TGS	AT 0200	352	10.8	4.17	1.81	1.52	45.0	19.5	16.4
Lakeview TGS	AT 0200	351	14.3	6.41	2.28	1.85	91.9	32.7	26.6
Lambton TGS	AT 0800	358	10.5	7.18	2.46	1.70	75.3	25.8	17.9
Nanticoke TGS	AT 0100	359	17.2	7.95	2.63	2.01	137	45.2	34.5
Thunder Bay TGS	AT 0200	356	10.5	5.45	2.07	1.78	57.4	21.7	18.7
Average Performance excluding Nanticoke			11.5	5.80	2.15	1.71	66.9	24.8	19.8
						Limits:	**70.0**	-	**25.0**

Aluminum, mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Atikokan TGS	AT 0200	52	2.20	5.27	2.03	n/a	11.6	4.46	n/a
Lakeview TGS	AT 0200	52	.649	5.16	2.00	n/a	3.34	1.30	n/a
Lambton TGS	AT 0800	51	.504	25.8	3.93	n/a	13.0	1.98	n/a
Nanticoke TGS	AT 0100	53	1.22	3.23	1.58	n/a	3.95	1.93	n/a
Thunder Bay TGS	AT 0200	52	1.01	3.26	1.59	n/a	3.30	1.60	n/a
Average Performance excluding Nanticoke			1.09	9.87	2.39	n/a	10.8	2.55	n/a
						Limits:	**13.0**	**4.5**	-

Iron, mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Atikokan TGS	AT 0200	154	.369	6.27	2.25	1.41	2.31	.830	.521
Lakeview TGS	AT 0200	154	.259	6.70	2.35	1.75	1.73	.607	.453
Lambton TGS	AT 0800	155	.226	7.21	2.46	1.51	1.63	.558	.341
Nanticoke TGS	AT 0100	156	.041	5.37	2.06	1.55	.222	.085	.064
Thunder Bay TGS	AT 0200	155	.520	4.78	1.92	1.38	2.48	.996	.717
Average Performance excluding Nanticoke			.343	6.24	2.24	1.51	2.14	.771	.519
						Limits:	**2.5**	**1.0**	-

5.5.3 Oily Water Separator Effluent

Oil and grease is the only parameter identified for effluent limits in effluent from oily water separators. Table 5.20 lists oil and grease concentration performance data collected for oil water separators at fossil stations during the MISA monitoring period. Limits are based on the average performance of the oily water separators at Lakeview and Thunder Bay. Concentrations of oil & grease were lowest in effluent from the systems at Lennox and Atikokan; however, these streams were not included in setting the oil and grease effluent limits because;

- The oil/water separation system at Atikokan receives large volumes of cooling water; therefore, the process content of this stream has been substantially diluted.

- The oil/water separation system at Lennox includes an API separator followed by dissolved air flotation. Upgrading of oily water separators at all stations to meet the performance of this system was not prescribed or costed under BAT option IA.

The oil/water separation systems installed at Lakeview and Thunder Bay are similar. Limits based on the average effluent quality attained by these systems will allow the maximum number of effluents to meet the limits imposed while not incurring unnecessary costs for upstream controls on releases of oil and grease or costs to increase treatment capability.

Compared to the ATWTS, oily water separator effluent streams are of lesser importance in this sector, therefore, the LSS agreed that limits compliance for these streams can be assessed by weekly sampling of effluent. The 13 mg/L monthly average oil & grease limit derived from the average effluent quality from separators at Lakeview and Thunder Bay is slightly less than the 15 mg/L effluent quality recommended under the Environment Canada Codes of Practice (15 mg/L) and the Ontario Industrial Discharge Guideline of 15 mg/L. Only Lakeview's oily water separator at control point 2300 exceeded the proposed limits during the MISA monitoring period.

The daily maximum limit of 28.7 mg/L is derived from the average performance (VF1's and LTA's for Lakeview and Thunder Bay stations.

Table 5.20
Oily Water Separator Effluent
Concentration Performance Data -- All Data

Oil & Grease (O & G), mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Atikokan TGS	OW 0600	152	1.79	4.80	1.96	1.41	8.57	3.50	2.53
Lakeview TGS	OW 2300	152	13.3	4.26	1.81	1.37	56.6	24.0	18.2
Lakeview TGS	OW 2400	149	6.38	3.82	1.71	1.26	24.4	10.9	8.05
Lennox TGS	OW 0300	130	1.97	4.69	1.85	1.29	9.25	3.64	2.55
Thunder Bay TGS	OW 1100	153	2.44	3.60	1.72	1.24	8.77	4.18	3.03
Avg. Perf. Lakeview and Thunder Bay:			7.36	3.89	1.74	1.29	28.7	12.8	9.50
						Limits:	**29.0**	**13.0**	-

5.5.4 Event Discharges

Effluent discharges from fossil stations which occur on an event basis include coal pile run-off, boiler acid washes, air pre-heater washes and other equipment cleaning effluent. Due to the infrequent occurrence of these discharges, only a limited quantity of data was collected during the MISA monitoring period. The handling of these streams differs at each station with some stations directing event wastewaters to the ATWTS and others discharge directly. Effluent limits for the ATWTS will apply for those sites co-treating these effluents in the ATWTS. With the exception of Lambton, for those sites discharging these streams independent of the ATWTS, the LSS decided that the monthly average limits for the ATWTS will apply to each event discharge. The rationale for this approach was that stations can exercise more control on the quality of event discharges because they are collected, treated, and prior to release may be checked to insure contaminant levels are within prescribed limits.

Coal Pile Effluent:

Table 5.21 contains concentration performance data for coal pile effluents which discharge directly (ie. independent of ATWTS) for those parameters identified for effluent limits; TSS, and iron.

Table 5.21
Coal Pile Effluent
Concentration Performance Data -- All Data

Total suspended solids (TSS), mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Atikokan TGS	CP 0400	7	1243	3.62	3.62	n/a	4500	4500	n/a
Lakeview TGS	CP 1800	16	11.9	4.12	1.77	n/a	49.1	21.2	n/a
Lambton TGS	CP 1100	12	6.83	7.50	2.53	n/a	51.2	17.3	n/a
						Limits:	**25**		**25**

Iron, mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Atikokan TGS	CP 0400	7	5.15	12.5	3.67	n/a	64.6	18.9	n/a
Lakeview TGS	CP 1800	16	.365	6.23	2.24	n/a	2.27	.816	n/a
Lambton TGS	CP 1100	12	.268	4.48	1.85	n/a	1.20	.50	n/a
						Limits:	**1.0**	**-**	**1.0**

Atikokan: Only seven discharge events were monitored during phase one monitoring. Flows monitored were very low. The LSS decided that each event discharge meet a daily TSS limit of 25.0 mg/L and an Iron daily limit of 1.0 mg/L. If the discharge duration exceeds one day then sampling of every day of discharge would be required to assess compliance with limits.

Lakeview: Sixteen discharges were monitored during the phase one monitoring period. The same limits as for Atikokan, will apply to the coal pile effluent event discharges at Lakeview.

Lambton: During analysis of the data reported for coal pile effluent at Lake Lambton it was discovered that this station discharged coal pile effluent continuously for nine months and reported 12 events of up to one month duration.

Lambton discharges coal pile runoff and boiler cleaning waste to Lake Lambton. Although only a limited quantity of data was collected for this stream, the levels of contaminants are well below the limits for the ATWTS. The LSS decided to treat Lake Lambton effluent as a special case because the sampling location is remote and the Lake Lambton provides in excess of 6 years of residence time for the wastewater discharged. The costs of labour to provide representative daily grab sampling or the costs of running a power line to enable automatic flow

proportional sampling were not justified for this effluent. The LSS agreed to apply ATWTS effluent limit numbers to the effluent from Lake Lambton with assessment of compliance for TSS, Aluminum and Iron levels based on weekly grab sampling.

5.5.5 Water Treatment Plant(WTP)- Neutralization Sump Effluent

Limits for neutralization sump effluent are identical to the limits for the ATWTS. The rationale for this approach is that three fossil stations discharge all water treatment plant waste streams to the ATWTS for co-treatment; therefore, WTP waste at these stations will be discharged at the effluent quality required for the ATWTS effluent. The other three stations discharge some or all of WTP waste independent of the ATWTS. Concentration performance data collected during the MISA monitoring period from these stations are provided in Table 5.22 for total suspended solids, aluminum and iron.

Lennox provides treatment for all WTP waste in a series of settling ponds. MISA performance data for Lennox's neutralization sump effluent indicate that effluent quality meets the limits developed for the ATWTS. Atikokan and Thunder Bay discharge some WTP waste directly to receiving waters which will also be required to meet the same limits as developed for the neutralization sump effluent. Based on the MISA monitoring data, neutralization sump effluent from Atikokan also meets the effluent quality required for the ATWTS for TSS and Aluminum. Thunder Bay's neutralization sump effluent quality exceeds the daily limit of 70.0 mg/L set for ATWTS effluent. The LSS agreed that Thunder Bay could meet these limits by reducing variability.

The limits are identical to ATWTS effluent limits and provide WTP waste stream limits which are based on existing treatment at three of the six fossil stations and allows the greatest number of stations to meet the limits without installing additional treatment. This approach also simplifies the limits because with the exception of oily water separator effluent, all fossil waste streams will be limited based on a common set of numbers derived from the performance of the ATWTS as discussed before.

The limits for iron will require either reduced variability or system upgrade at the Atikokan and Thunder Bay sites.

The LSS also agreed that aluminum limits for WTP waste, discharged independently of the ATWTS, should apply only to those stations using aluminum based WTP chemicals.

Table 5.22
Water Treatment Plant Neutralization Sump Effluent
Concentration Performance Data -- All Data

Total suspended solids (TSS), mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Atikokan TGS	NS 0800	112	14.8	3.60	1.67	1.25	53.2	24.7	18.5
Lennox TGS	NS 2300	151	4.95	2.11	1.32	1.13	10.5	6.52	5.58
Thunder Bay TGS	NS 1500	138	13.6	8.82	2.84	1.86	120	38.6	25.3
Average Performance all stations:			11.1	4.84	1.94	1.41	53.8	21.6	15.7
						Limits:	**70.0**	-	**25.0**

Aluminum, mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Atikokan TGS	NS 0800	50	1.42	4.92	1.95	n/a	6.98	2.77	n/a
Lennox TGS	NS 2300	51	.069	2.78	1.48	n/a	.192	.102	n/a
Thunder Bay TGS	NS 1500	46	1.09	6.51	2.30	n/a	7.11	2.52	n/a
Average Performance all stations:			.860	4.73	1.91	n/a	4.07	1.64	n/a
						Limits:	**13.0**	**4.50**	-

Iron, mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Atikokan TGS	NS 0800	114	1.76	4.89	1.94	1.35	8.59	3.41	2.38
Lennox TGS	NS 2300	151	.467	3.49	1.64	1.35	1.63	.763	.632
Thunder Bay TGS	NS 1500	138	.728	7.64	2.56	1.59	6.67	1.86	1.15
Average Performance all stations:			.984	5.34	2.05	1.43	5.25	2.01	1.41
						Limits:	**2.5**	**1.0**	-

5.6 Effluent Limits for the Nuclear Stations

As discussed in section 5.2 the economic assessment of the BAT options for nuclear stations indicated that limits should be developed based on effluent quality recommended under the Environment Canada Codes of Practice option. Through consultation with Ontario Hydro and a review of the effluent qualities recommended under the Codes of Practice as compared to the levels of parameters found during MISA monitoring, some deviation from the Codes of Practice option was allowed. During limit setting consultations, the Codes of Practice Option served only as a guide for effluent quality attainable.

A difficulty with applying the effluent quality recommended by the Codes of Practice to the development of MISA effluent limits is that the Codes of Practice prescribe effluent quality through seven day composite samples. The available time period for sampling for limits compliance under the MISA program are monthly averages based on daily or weekly sampling. All daily concentrations should be compared to a daily maximum limit. For purposes of comparison with MISA monitoring data and this regulation, the LSS decided to assume the recommended effluent qualities specified under the Codes of Practice as approximately equivalent to a monthly average limit based on four weekly samples.

5.6.1 Radioactive Liquid Waste Management System Effluent

Due to design differences between stations, the quality and volumes of effluent from RLWM systems vary widely between stations. Effluent volumes are greater at the two oldest stations. Radioactive liquid waste management system wastewater is often discharged untreated at all stations. Treatment by ion exchange/filtration is available at all stations but is applied only when necessary to comply with radioactivity criteria set by the Atomic Energy Control Board (AECB). Under the Environment Canada Codes of Practice Option, continuous ion exchange/filtration was prescribed for wastewater discharged from the RLWMS.

MISA performance data for concentrations of the parameters identified for limits; total suspended solids, oil & grease, iron, zinc and phosphorus, in effluent from RLWMS are listed in Table 5.23. Table 5.23 also provides the average performance for all stations. Effluent qualities recommended under the Environment Canada Codes of Practice (ECCP) are 25 mg/L for TSS, 1.0 mg/L for iron, 0.5 mg/L for zinc and 15 mg/L for oil & grease based on seven day composite samples. The Codes of Practice do not specify an effluent quality for phosphorus.

A review of MISA performance data indicates that most stations are currently meeting the effluent qualities recommended by the Codes of Practice for TSS, zinc and oil & grease. Darlington exceeds the ECCP for TSS and zinc. Pickering and Darlington exceed the Codes for oil & grease. Only Pickering NGS has iron levels below the 1.0 mg/L level recommended by the ECCP.

Ontario Hydro agreed that, with the exception of iron levels, effluent quality from the RLWM systems could be improved by employing best management practices (ie. pumping out and disposing accumulated sludge from the radioactive liquid waste tanks and upstream control of oil); however, the high iron

levels, due to corrosion of the extensive network of carbon steel piping, may not be controllable through management practices. Ontario Hydro predicted that an iron limit placed at a monthly average of 1.0 mg/L may force installation of additional treatment. The LSS agreed that although concentrations of iron exceeded the goals of the ECCP BAT option the loadings were not of significant concern to warrant a 1.0 mg/L monthly average limit and force installation of expensive treatment for iron only. The total iron loading from RLWMS at the four nuclear stations was only 0.68 kg/day during the MISA monitoring period.

The limits setting subcommittee agreed that limits for RLWMS should be set at the average performance from all of the nuclear stations for the parameters TSS, iron, zinc and oil & grease. Those stations with poorer than average performance would be expected to improve utilizing in-plant changes. Limits based on the average performance of all stations are lower than effluent qualities recommended in the Environment Canada Codes of Practice for the parameters oil & grease and zinc. TSS daily maximum limits of 21 mg/L based on all station average performance are close to TSS levels (25 mg/L) recommended under the Codes of Practice.

The LSS agreed to set only a monthly average (weekly sampling) limit for phosphorus at 1 mg/L based on the IJC recommended effluent quality for discharges to the Great Lakes. Technology was not identified in the electric power generation sector for control of phosphorus; however, LSS agreed that phosphorus use could be reduced to meet a limit of 1 mg/L.

Limits based on daily sampling will be used to assess compliance with TSS levels. Limits for all other parameters were derived for a weekly sampling frequency (M4LIM).

Table 5.23
Radioactive Liquid Waste Management System Effluent
Concentration Performance Data (All Data)

Total suspended solids (TSS), mg/L

Station	CtrlPt	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Bruce - A	RL 0100	7.24	3.74	1.69	1.27	27.1	12.2	9.21
Bruce - B	RL 0100	6.94	5.26	2.03	1.37	36.5	14.1	9.53
Darlington	RL 0100	40.1	5.25	2.02	1.34	210	81.1	53.7
Pickering NGS	RL 0200	10.0	3.87	1.72	1.28	38.8	17.3	12.8
Average Performance of all Stations →		16.1	4.53	1.87	1.32	73	30	21
					Limits:	**73.0**	**-**	**21.0**

Table 5.23 (cont'd.)
Radioactive Liquid Waste Management System Effluent
Concentration Performance Data (All Data)

Oil and Grease (mg/L)

Station	CtrlPt	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Bruce - A	RL 0100	1.88	5.28	2.03	1.45	9.93	3.83	2.73
Bruce - B	RL 0100	3.49	6.52	2.28	1.41	22.8	7.98	4.91
Darlington	RL 0100	6.09	7.93	2.61	1.65	48.3	15.9	10.0
Pickering	RL 0200	11.2	6.03	2.20	1.41	67.4	24.6	15.8
Average Performance of all Stations →		5.66	6.44	2.28	1.48	36	13	8
					Limits:	**36.0**	**13.0**	-

Zinc, ug/L

Station	CtrlPt	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Bruce - A	RL 0100	161	5.61	2.10	1.38	904	339	223
Bruce - B	RL 0100	109	4.80	1.92	1.30	523	210	141
Darlington	RL 0100	3655	8.14	2.68	1.65	2980	980	601
Pickering	RL 0200	160	4.32	1.82	1.28	690	291	204
Average Performance of all Stations →		199	5.72	2.13	1.40	1140	424	279
					Limits:	**1000**	**500**	-

Iron, Unfiltered Total, ug/L

Station	CtrlPt	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Bruce NGS - A	RL 0100	1360	10.1	3.15	1.87	13800	4290	2540
Bruce - B	RL 0100	925	4.24	1.80	1.30	3920	1670	1200
Darlington	RL 0100	2140	11.4	3.44	2.01	24400	7370	4320
Pickering	RL 0200	483	3.41	1.62	1.19	1650	784	576
Average Performance of all Stations →		1228	7.29	2.50	1.59	8950	3080	1960
					Limits:	**9000**	**3000**	-

Phosphorus, mg/L

Station	CtrlPt	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Bruce - A	RL 0100	4.08	8.96	2.87	1.83	36.5	11.7	7.44
Bruce - B	RL 0100	1.73	8.54	2.77	1.61	14.8	4.80	2.78
Darlington	RL 0100	1.33	5.23	2.04	1.43	6.95	2.71	1.91
Pickering	RL 0200	1.29	6.35	2.27	1.37	8.20	2.93	1.76
Average Performance of all Stations →		2.11	7.27	2.49	1.56	15	5	3
					Limits:	-	**1.0**	-

5.6.2 Neutralization Sump Effluent

Performance of neutralization sump effluent quality varies widely from station to station because of differing WTP configurations and treatment chemical usage; however, the purpose of the water treatment plant, to produce high quality boiler feedwater, is the same at all stations. The limit setting subcommittee proposed that, in order to be impartial between

nuclear and fossil sub-sectors, a common set of limits for all WTP waste effluent should be used.

At fossil stations, BAT treatment for neutralization sump effluent was identified as co-treatment with boiler ash effluent in the stations ATWTS.

Based on MISA performance data, the effluent limits for TSS, iron and aluminum listed in Table 5.24 were developed for the ATWTS at fossil stations. WTP waste streams discharging independently of the ATWTS effluent are also expected to meet these limits. (ie. three fossil stations, Atikokan, Thunder Bay and Lennox, discharge ion exchange regeneration waste independently of the ATWTS). No additional parameters were identified for limits in effluent from WTPs at nuclear stations.

Table 5.24
Fossil Subcategory Concentration Limits for
ATWTS/Neutralization Sump Effluent

Parameter	Sampling Frequency	Daily Maximum Concentration, mg/L	Monthly Average Concentration, mg/L
Total suspended solids	Daily	70	25
Iron	Weekly	2.5	1.0
Aluminum	Weekly	13	4.5

The effluent quality recommended under the Environment Canada Codes of Practice is 25 mg/L for TSS and 1.0 mg/L for iron based on a 7 day composite samples. Daily maximum concentrations are not specified.

The limit for TSS developed for fossil stations is slightly less stringent than the effluent quality recommended under the Codes of Practice; however, recognizing that the primary benefit from limiting nuclear WTP waste streams is to be gained from the loading reductions achievable at Bruce-B, the Limit Setting Subcommittee decided that the nuclear sub-sector should adopt WTP limits developed for the fossil sub-sector. The fossil sub-sector limits will force installation of WTP effluent treatment at Bruce-B while not substantially penalizing other nuclear station WTPs whose performance is better. A common set of limits for both fossil and nuclear WTPs also results in no bias between the subcategories.

MISA performance data for concentrations of total suspended solids, iron and aluminum in effluent from neutralization sumps at nuclear stations are provided in Table 5.25.

Table 5.25
WTP - Neutralization Sump Effluent
Concentration Performance (All Data)

Total suspended solids (TSS), mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Bruce NGS-A	NS 1400	151	2.40	5.73	2.13	1.45	13.8	5.12	3.49
Bruce NGS-B	NS 2000	156	147	4.06	1.76	1.27	597	259	187
Darlington	NS 2200	56	6.41	12.1	3.51	N/A	77.7	22.5	N/A
Pickering	NS 3100	146	19.7	7.26	2.48	1.46	143	48.7	28.8
						Limits	**70.0**	-	**25.0**

Iron, ug/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Bruce NGS-A	NS 1400	147	188	4.68	1.90	1.28	879	356	240
Bruce NGS-B	NS 2000	155	970	5.44	2.07	1.57	5270	2000	1520
Darlington	NS 2200	59	427	4.94	1.95	N/A	2110	834	N/A
Pickering	NS 3100	147	514	3.88	1.72	1.30	1990	885	667
						Limits:	**2500**	**1000**	-

Aluminum, ug/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Bruce NGS-A	NS 1400	52	83.5	3.85	1.71	N/A	322	143	N/A
Bruce NGS-B	NS 2000	51	25100	3.29	1.79	N/A	82700	45100	N/A
Darlington	NS 2200	38	171	3.96	1.74	N/A	675	297	N/A
Pickering	NS 3100	51	1100	3.16	1.56	N/A	3460	1710	N/A
						Limits:	**13000**	**4500**	-

Neutralization sump data from Bruce-A were not considered when assessing the performance of nuclear station WTPs because filter backwash was not monitored at this station. Design of a new WTP under construction at Bruce-A includes recycle of filter backwash streams. Clarifier sludge will be collected in a sludge pond for periodic disposal to landfill. The new WTP at Bruce-A is scheduled for start-up by end 1994.

A comparison of the WTP limits developed for the fossil subcategory and MISA performance data from WTPs at Bruce-B, Darlington and Pickering indicates that none of the nuclear stations currently meet both the monthly average and the daily TSS limits developed for WTP waste at fossil stations. Darlington can meet the TSS daily limit (70.0 mg/L) with only a small reduction in daily variability. When completed, it is expected that the new WTP at Bruce-A will meet the proposed TSS

limits. In anticipation of MISA effluent limits, Bruce-B has recently (commissioned in January 1994) installed additional treatment for control of WTP waste. Pickering will need to reduce process variability, recycle filter backwash or install additional treatment. Darlington and Pickering, as presently configured, can meet the iron and aluminum limits developed for the fossil subcategory. It is also expected that the new treatment systems at Bruce-A and Bruce-B will enable these stations to meet both the aluminum and iron limits.

5.6.3 Oil/Water Separator Effluent

Concentration performance data for oil/water separator effluent at Darlington and Pickering are provided in Table 5.26. Wastewater is collected and treated on a batch basis by these systems. The application of the oil/water separators at Pickering is primarily a management practice to control oil in the event of spills. The discharge volumes at Pickering were very low during the MISA period. Small volumes of wastewater (<1 m3/discharge) were discharged. The system at Darlington was not fully operational during the MISA monitoring period; therefore, the monitoring data cannot be taken as representative of the systems performance.

Performance of oil/water separators is variable and depends on the concentration and form of the oil to be separated. The limit setting subcommittee decided to adopt the 15 mg/L oil and grease limit recommended under the Environment Canada Codes of Practice to be applied to each event discharge from these systems.

Table 5.26
Oil/Water Separator Effluent
Concentration Performance (All Data)

Oil and Grease, mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
Darlington	1900	11	1.78	3.67	1.68	N/A	6.53	2.99	N/A
Pickering	3600	6	17.2	11.8	3.53	N/A	203	60.8	N/A
Pickering	2700	6	3.34	5.60	2.10	18.7	18.8	7.01	N/A
						Limits:	**15.0**	-	-

Effluent Limits for Nuclear Associated Facilities

5.7 Bruce Heavy Water Plant (BHWP)

Effluent limits were developed for only process effluent (0500) and the process effluent lagoons (0400) at the Bruce Heavy Water Plant. The rationale for not limiting other streams is described in the following sections. A list of all parameters found in effluent at the BHWP is provided in Appendix B, Table 26 and 27.

The economic assessment of BAT options identified the Environment Canada Codes of Practice Option as most cost effective at BHWP. Under this option additional treatment is prescribed for "building effluent" (ie. WTP filter backwash combined with cooling water and condensate) and storm waters.

5.7.1 "Building Effluent", BE 0100

The Environment Canada Codes of Practice Option recommends the recycle of filter backwash in order to reduce TSS levels found in effluent monitored at MISA control point 0100. As currently configured, filter backwash from the WTP is combined with other effluent, comprised predominantly of cooling water and condensate, upstream of the monitoring point (0100). Treatment chemicals are not added prior to filtration; therefore, the elevated levels of TSS found represent suspended material which is concentrated from the intake water on the WTP filter beds. The limit setting subcommittee decided that because filter backwash does not contact any process chemicals and the discharge at control point 0100 is comprised predominantly of cooling water and condensate, this stream may be excluded from effluent limits. No other parameters were found at significant levels.

5.7.2 Storm Waters, SW 0700 and SW 0800

Under the Environment Canada Codes of Practice option untreated storm waters are directed to the surface water treatment facility. The BAT consultant recommended routing of these streams to the surface water treatment facility because of elevated high iron levels found during MISA monitoring. These storm waters also contain some process effluent which is primarily condensate and not expected to contain elevated levels of iron or other contaminants. The Limit Setting Subcommittee agreed that the untreated storm waters monitored at control points 0700 and 0800 be addressed under the regulation requirements of conducting a storm water control study.

5.7.3 Surface Water Treatment Facility (SWTF) - 0600

The surface water treatment facility accepts predominantly surface run-off from various areas of the Bruce Heavy Water Plant. Process effluent which is discharged to the SWTF was monitored upstream at control point 0300. The volumes of process effluent represent a small proportion of the volume entering the SWTF. Based on a review of all parameters found in samples collected at control point 0300, only iron and sulphide were found at significant levels. The LSS agreed that the SWTF should be addressed under the regulation requirements of conducting a storm water control study. The discharges from the SWTF are regulated under a ministry Certificate of Approval.

5.7.4 Process Effluent and Effluent Lagoons Effluent - Control Points 0500 & 0400

The main process chemical used in the production of heavy water is hydrogen sulphide and BAT technology is installed at the Bruce Heavy Water Plant for control of H_2S. This consists of a flash tank and steam stripping (0500) for recovering H_2S and an aerated lagoon (0400) where wastewater containing elevated levels of H_2S can be directed in case of plant upsets. None of the BAT options prescribed additional treatment for the process effluent or effluent lagoons. The Limit Setting Subcommittee agreed that limits for sulphide should be set for both process effluent (0500) and the effluent lagoons (0400) based on the effluent quality attained by the existing treatment systems on these streams. No other parameters were found at significant levels.

Process Effluent - 0500

Concentration performance data collected during the MISA monitoring period for sulphide (364 observations) are presented in Table 5.27. After the MISA monitoring period the Bruce Heavy Water Plant was required to continue daily sampling for sulphide on the process effluent. Table 5.28 provides variability analysis of the more extensive sulphide data (851 observations) collected after the MISA monitoring period. The limits suggested by both sets of data are in close agreement.

Table 5.27
Bruce Heavy Water Plant -- Process Effluent
MISA Concentration Performance Data

Sulphide, mg/L -- All Data

Facility	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
BHWP	PR 0500	364	0.028	7.99	2.64	1.76	0.23	0.075	0.050

Table 5.28
Bruce Heavy Water Plant -- Process Effluent
Post MISA Monitoring Concentration Performance Data

Sulphide, mg/L -- All Data

Facility	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
BHWP	PR 0500	851	0.035	7.19	2.46	1.48	0.25	0.086	0.052

MOEE proposed limits for the process effluent (0500) as shown in Table 5.29.

Table 5.29
Proposed Sulphide Limits for
Process Effluent (0500) and Process Effluent Lagoon Effluent (0400)

ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
15	Sulphide	Daily	0.25	.052

Process Lagoon Effluent - 0400

Sulphide was not listed as a candidate for effluent limits at control point 0400 according to the parameter selection procedure described under section 5.3.1; however, because H_2S is the primary process chemical used, the LSS agreed that a sulphide limit for the process effluent lagoons was justified. MOEE proposed to Ontario Hydro that sulphide limits for the effluent lagoons should be similar to limits proposed for the process effluent.

Sulphide Limit "Negotiation"

Ontario Hydro indicated that the monthly reporting for the effluent lagoons provided under the MISA monitoring phase did not provide sufficient data on the lagoon's effluent quality. Ontario Hydro presented more extensive data on the lagoon effluent, for the period June 1/90 to March 20/94[13]. This data shows 18, 23 and 58 days of lagoon discharge for the years 1991, 1992 and 1993 respectively. With three outliers deleted, variability analysis of this data, presented in Table 5.30, would

suggest a daily limit of 2.83 mg/L for the process effluent lagoons effluent.

Table 5.30
Bruce Heavy Water Plant -- Process Lagoon Effluent
Concentration Data June 1/90 to March 20/94
Submitted to MOEE May 30/94

Sulphide, mg/L -- All Data (1990 - 1994)

Facility	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
BHWP	PR 0400	144	0.192	14.7	3.82	-	2.83	0.735	-

Ontario Hydro requested that the proposed daily limit for the process effluent be relaxed to 1 mg/L and the proposed daily limit for the process effluent lagoon be relaxed to 2 mg/L.

Ontario Hydro maintained that, because the Bruce Heavy Water Plant is an unique plant and BAT technology is in-place on the process effluent, the plant should not exceed limits; however, MISA and post MISA monitoring data show a number of instances of noncompliance (Table 5.31) with the proposed sulphide limits for the process effluent (0500). Additional data submitted for the effluent lagoons also indicate that proposed limits will not be met without installation of further treatment which is not costed under any of the BAT options.

Ontario Hydro estimated that costs to attain a lagoon effluent quality similar to the process effluent would require installation of a steam stripping system at an estimated capital cost of $7.3 million[13].

Table 5.31
Instances of Non-compliance with Proposed Sulphide Limits
for Process Effluent - Control Point 0500

Year	Number of Monthly Averages Exceeding the Proposed 0.05 mg/L Monthly Average Sulphide Concentration Limit	Number of Daily Samples Exceeding the Proposed 0.25 mg/L Daily Sulphide Concentration Limit
1990 (7 months)	0	2
1991 (12 months)	4	4
1992 (12 months)	0	3
1993 (11 months)	4	6

The MOEE suggested that the sulphide limits for the process effluent lagoons (0400) should not be higher than the process effluent (0500) limits because it would allow, or even promote, more frequent diversion of process effluent to the lagoons if the limits were higher. Hydro agreed that, as a compromise, the BHWP would accept a daily limit of 0.8 mg/L for both the process effluent and the process effluent lagoons. With one extreme outlier (6.9 mg/L on March 8/93) excluded, 0.8 mg/L is the highest sulphide concentration measured at control point 0500 during the MISA monitoring or post MISA monitoring period.

Because 0.8 mg/l concentrations of sulphide may be lethal to rainbow trout and Daphnia magna according to literature, MOEE allowed an alternate downstream control point only for toxicity sampling after these effluents are tempered with cooling water but before their discharge to Lake Huron.

5.8 Bruce Nuclear Power Development (BNPD)

Economic assessment of the BAT options identified the Minimum Discharge Option as the most cost effective for Bruce Nuclear Power Development. Reductions in loadings predicted from implementation of this option are due to 100% reuse of effluent through control points:

0200 - steam transformer plant - A
0300 - steam transformer plant - A
0400 - steam transformer plant - O
0600 - chemical waste pond
1400 - Neutralization sump effluent.

After a review of parameters and levels found in effluent from the BNPD site the LSS agreed that effluent limits based on the Minimum Discharge Option were not justified for this site. The minimum discharge option was identified as most cost effective only because no reductions in loadings or costs were estimated under the Environment Canada Codes of Practice Option.

No reductions or capital costs are associated with the Codes of Practice Option because no parameters were found at concentrations above the effluent quality recommended by the Codes. Wastewaters from the steam transformer plants are comprised predominantly of cooling water and condensate and parameters found in these streams were at low untreatable levels.

The primary process effluents discharged from the BNPD site are the sewage treatment plant and the neutralization sump effluent. A list of all parameters found in effluent at the BNPD

is provided in Appendix B, Tables 19, 26, 27, 40, and 41.

Effluent limits at Bruce Nuclear Power Development were developed for the sewage treatment plant (0100), the WTP (1400) and the chemical waste pond (0600). The rationale for limiting these streams and excluding other monitored streams is summarized in the following sections.

5.8.1 Steam Transformer Plants (STP) - 0200, 0300 & 0400

Wastewaters discharged through these control point are primarily cooling water and condensate and are discharged untreated. Levels of all contaminants found are at low untreatable levels and are similar to water in-take levels; therefore, the LSS recommended that these effluents be excluded from limits.

5.8.2 Radioactive Waste Storage Site - 1300

Drainage from the radioactive waste storage site is due to stormwater only. The LSS agreed that any parameters of concern in these stormwaters would be addressed under the regulation requirement to conduct a storm water control study.

5.8.3 Chemical Waste Pond - 0600

The chemical waste pond receives waste from air pre-heater washing and boiler cleaning at the Bruce Steam Plant. Only two discharges occurred from this pond during the MISA monitoring period. The source of these waste waters are identical to those generated at fossil stations; therefore, the LSS decided to apply limits developed for event discharges (equipment cleaning effluents) from fossil stations to this effluent.

5.8.4 WTP - Neutralization Sump Effluent - 1400

The neutralization sump is discharged upstream of control point 0400 at BNPD. Levels of contaminants found at the discharge from the neutralization sump (1400) were low; however, filter backwash is not directed to the neutralization sump at this site. Filter backwash is discharged with effluent from STP-O and is diluted prior to reaching the downstream monitoring point (0400). To be consistent with limits applied to all other water treatment plants in the Electric Power Generation Sector the LSS agreed that limits applied to WTPs at fossil and nuclear stations should also apply to the WTP at BNPD.

5.8.5 Sewage Treatment Plant - 0100

Biological treatment (activated sludge) technology is installed at BNPD for treatment of all sanitary and some industrial waste. Monitoring data collected from this system over the MISA monitoring period indicate levels of contaminants are below the effluent quality recommended by Ministry policies for effluent from secondary treatment systems. This is the primary process stream discharged from BNPD. Upgrading this treatment system was not specified under any of the BAT options. A biological treatment system is also installed at the Darlington Construction Site. The LSS agreed that a common set of effluent limits for these treatment systems should be developed. Effluent limits for both STPs are discussed under section 5.9.4.

5.9 Darlington Construction Site

Economic assessment of BAT options identified the Environment Canada Codes of Practice Option as most cost effective for the Darlington Construction Site.

Under the Environment Canada Codes of Practice Option additional treatment is prescribed for neutralization sump effluent, boiler blowdown and equipment cleaning lagoon effluent. Effluent limits were developed only for the sewage treatment plant. The rationale for excluding other streams from limits is discussed below.

A review of all parameters found in effluent from the Darlington Construction Site is listed in Appendix B, Tables 26, 33, 40 and 41.

5.9.1 Neutralization Sump Effluent

The water treatment plant used for supplying demineralized water to the temporary construction boilers at the Darlington Construction Site are permanently shutdown; therefore, limits were not developed.

5.9.2 Boiler Blowdown

Levels of contaminants found in blowdown from the construction boilers used for supplying heating steam during the construction of Darlington NGS showed levels of contaminants which were typically higher than the generating boilers at nuclear stations; however, the construction boiler are now

permanently shutdown.

The operation of the tritium removal facility will be ongoing; however, the rationale for excluding this blowdown effluent from the regulation are the same as those for blowdown from fossil and nuclear stations discussed under section 5.3.4. The LSS agreed (after obtaining MOEE management approval) to exclude boiler blowdown from this regulation.

5.9.3 Equipment Cleaning Effluent

Commissioning Waste Lagoons, 0400 and 0500

Only three discharges were monitored during the MISA monitoring period. After reviewing all parameters found in the waste lagoons effluent, the LSS decided to limit these very infrequent event discharges for the same parameters (TSS and Iron) as the fossil and nuclear subcategories.

Rinse Tank Effluent (Tanks 2 & 4) - Control Points 0600 and 0700

Wastewater from rinse tanks at the pipe treating facility is discharged to the sewage treatment plant. After a review of all parameters found in effluent from the rinse tanks, the LSS agreed to exclude these streams from effluent limits. Only phosphorus was found at treatable levels; however, the phosphorus contribution from the rinse tanks is expected to be a small proportion of the phosphorus loading from the STP at the Darlington construction site. These discharges are upstream of the sewage treatment plant which will be limited for phosphorus and are therefore excluded from this regulation.

5.9.4 Sewage Treatment Plants

Biological treatment (rotating biological contactor) is installed at the Darlington Construction Site for the treatment of all sanitary and some industrial waste. The limit setting subcommittee agreed that, where possible, MISA performance data be used for limiting the sewage treatment plants at BNPD and the Darlington Construction Site and that a common set of numerical limits was desirable. Through review of all candidate parameters for limits TSS, ammonia + ammonium, total phosphorus and oil & grease were identified as parameters controllable by biological treatment. MISA concentration performance data for these parameters are provided in Table 5.32.

Table 5.32
Sewage Treatment Plant Effluent
Concentration Performance (All Data)

Total suspended solids (TSS), mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
BNPD	PR 0100	363	6.73	3.51	1.64	1.21	23.6	11.1	8.15
Darl. Const.	PR 0800	357	15.3	2.87	1.50	1.20	44.1	23.0	18.4
						Limits:	**44.0**	-	**18.0**

Ammonia + Ammonium, mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
BNPD	PR 0100	156	1.94	13.0	3.75	2.86	25.2	7.28	5.56
Darl. Const.	PR 0800	155	3.40	5.28	2.04	1.43	18.0	6.93	4.85
						Limits:	-	**7.0**	-

Total Phosphorus, mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
BNPD	PR 0100	151	0.293	2.34	1.38	1.20	0.683	0.403	0.350
Darl. Const.	PR 0800	152	3.69	1.85	1.25	1.12	6.82	4.62	4.14
					Limits:	**BNPD:**	-	**1.0**	-
					Limits:	**Darl.Con**	-	**4.6**	-

Oil and Grease, mg/L

Station	CtrlPt	N	LTA	VF1	VF4	VF30	DAYLIM	M4LIM	M30LIM
BNPD	PR 0100	O&G was not found as priority 1 parameter in effluent from STP at BNPD							
Darl. Const.	PR 0800	149	4.10	9.17	2.86	18.4	37.7	11.8	7.55
						Limits:	**38.0**	**12.0**	-

Currently sewage treatment plants in Ontario are controlled under Certificates of Approval. Effluent limits and sampling requirements are written into C of A's according to Ministry policies (Table 5.33) for sewage treatment plants.

Table 5.33
Ministry Policies for Operation of Sewage Treatment Plants

Policy Number	Policy Title
08-01-01	Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters
08-04-01	Policy to Govern the Provision and Operation of Phosphorus Removal Facilities at Municipal, Institutional and Private Sewage Treatment Works
08-06-01	Policy to Govern Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only)

The policies describe levels of treatment and monitoring required for municipal and private sewage treatment works discharging to surface waters. Higher than normal treatment or more intensive reporting can be justified by appropriate site-specific receiving water assessments.

Policy 08-06-01[20] requires analysis be reported at least monthly for TSS, BOD_5, ammonia plus ammonium and total phosphorus. Ammonia plus ammonium is monitored primarily for the purpose of building a data base to define performance of individual sewage treatment works. TSS, BOD_5, and total phosphorus are monitored to assess compliance with ministry effluent guidelines or effluent limits written into certificates of approval. Policy 08-01-01[15, 16, 17, 18] recommends STPs achieve an annual average effluent quality of 25 mg/L for TSS and BOD_5. Secondary treatment systems should be designed to achieve an effluent quality of 15 mg/L for TSS and BOD_5. Requirements for phosphorus removal are specified under Policy 08-04-01[19]. Phosphorus requirements relevant to the Ontario Hydro STPs are those applicable to Lakes Ontario and Huron. STPs sited on these water bodies with wastewater discharge rates greater than 4,546 m^3/day are required to achieve and annual average phosphorus concentration of 1.0 mg/L. There are currently no phosphorus requirements for STPs on Lakes Ontario or Huron which discharge less than 4,546 m^3/day.

The LSS agreed that because Ontario Hydro STPs receive primarily sanitary waste the limits developed should not be substantially different than those applied to municipal plants.

Total Suspended Solids

Levels of TSS found in effluent from the STP at BNPD were well below design levels specified under Ministry Policy whereas

TSS levels at Darlington were similar to effluent objectives for TSS. Both the STP at Darlington Construction and at BNPD are secondary biological treatment systems identified as BAT in the AWT/Metcalf & Eddy BAT report. Because both of the existing plants were identified as BAT, additional treatment was not costed under any of the BAT options and further reductions in loadings are not expected. The LSS agreed that no benefit was to be gained from limiting the BNPD STP based on its better performance. Effluent limits based on the performance from the Darlington STP would be consistent with Ministry design objectives for STPs treating normal municipal sewage and not inconsistent with the control of all other STPs in Ontario.

Ammonia plus Ammonium

Levels of ammonia plus ammonium were similar in effluent from both the STP at Darlington and BNPD. The LSS agreed to place limits on ammonia plus ammonium based on the performance of the Darlington STP. The LSS agreed that compliance would be based on a monthly average only (weekly sampling).

Total Phosphorus

For STPs discharging to Lakes Ontario or Huron, Ministry policy requires phosphorus removal only for STPs with an average wastewater volume greater that 4546 m^3/day; however, the STP at BNPD, which discharges only 1000 m^3/day, has phosphorus removal installed. Because the BNPD STP has phosphorus removal installed the LSS decided that a 1 mg/L phosphorus limit was justified for this plant.

Darlington does not have phosphorus removal installed; therefore, Ontario Hydro requested that this STP not be limited for phosphorus at 1 mg/L. Darlington flow and phosphorus data collected during the MISA monitoring period are provided in Table 5.34.

Table 5.34
Darlington Sewage Treatment Plant

Average Flow	390 m^3/day
Average Phosphorus Concentration	3.69 mg/L
Average Phosphorus Loading	1.54 kg/day

The presence of phosphorus is primarily due to sanitary waste. Other sources of phosphorus are a truck washing facility

and pipe pickling plant which uses phosphoric acid for treatment of piping. Ontario Hydro indicates that these sources are a minor contribution to the phosphorus loading from the STP.

Ontario Hydro estimated the capital cost of installing phosphorus removal on the Darlington STP to meet an effluent quality of 1 mg/L at approximately $600,000[14]. The costs are higher than expected because of the common wall construction of the aeration and settling tanks on this system.

The LSS/JTC agreed to a monthly average (weekly sampling) phosphorus limit of 4.6 mg/L based on the performance data collected from the Darlington STP during the MISA monitoring period (Table 5.32).

Oil and Grease

Oil and grease was found only in effluent from the STP at Darlington. Ministry policies do not specify recommendations for oil and grease levels for STPs. The LSS agreed to set an oil and grease limit based on the performance data collected from the Darlington STP.

Biochemical Oxygen Demand (BOD_5)

Biochemical oxygen demand was not sampled during the MISA monitoring period; however, limits on BOD_5 are necessary to insure control of oxygen depletion in receiving waters. BOD_5 analysis is also a necessary control parameter for the day-to-day operation of an STP. Because BOD_5 was not monitored during the MISA monitoring period the Limits Setting Subcommittee decided to adopt BOD_5 limit numbers consistent with Ministry Policy 08-01-01; however, the sampling frequency would be increased to weekly and the 25 mg/L value would be interpreted as a monthly average. A daily BOD_5 limit could not be determined because the required performance data is unavailable.

5.10 Assessment Monitoring of Cooling Water

The high flow condenser cooling water (Table 37 and 38 in appendix B) streams are not being monitored for assessment because all upstream process effluent discharges are being limited. Also the very high dilution and resultant masking in this stream will not allow any detection of contaminants introduced by the site operations. Thermal monitoring will continue under current C of A requirements. Appendix B, Tables 50 to 52 summarize the monitoring phase temperature data

collected and is included for the record.

5.11 Overall Implications of MISA Effluent Limits for Ontario Fossil & Nuclear Subcategories

The economic assessment of options studied for the EPGS subcategories points towards adopting limits based on average performance of the current systems in place in this sector. The only exception is the upgrading of the untreated ash quench water and boiler seal water discharges from the three fossil stations as discussed under 5.5.1 and Section 4 of this document.

The implementation of the MISA concentration limits discussed earlier in this chapter will bring all process effluent up to an average Ontario standard in the fossil subcategory while generally maintaining current levels of performance in the nuclear subcategory and its associated facilities. The only note worthy improvement in the nuclear subcategory will result from reduction of high level of total suspended solids at the Bruce NGS-B water treatment plant.

Tables 5.35 and 5.36 below summarize the annual contaminant loading removal estimates of limited parameters as a result of implementing this regulation.

Table 5.35
Estimated Loading Removal Summary (kg/year)
For the Electric Power Generation Sector
Fossil Subcategory

Parameter	1990/91 Loading	Total Loading Removed	Total Loading Remaining	Percent Loading Removal
TSS	999,000	729,000	270,000	73%
Aluminum	24,000	0	24,000	0%
Iron	3,000	700	2,300	23%
Oil and Grease	24,000	70	23,930	0.3%

Table 5.36
Estimated Loading Removal Summary (kg/year)
For the Electric Power Generation Sector
Nuclear Subcategory

Parameter	1990/91 Loading	Total Loading Removed	Total Loading Remaining	Percent Loading Removal
TSS	53,000	38,000	15,000	72%
Aluminum	8,000	5,000	3,000	63%
Iron	2,000	40	1,960	2%
Oil and Grease	37,000	0	37,000	0%

5.12 Comparison of Limits with Other Jurisdictions

US Steam Electric Power Generating Point Source Category

Tables 5.37[5] and 5.38[5] present effluent limits developed by the US Environmental Protection Agency for the US Steam Electric Power Generating Point Source Category. The US effluent limits are concentration based. Table 5.37 contains new source performance standards for steam electric power stations constructed after 1983 while table 5.38 contains best available technology (BAT) standards for power stations constructed before 1983. State agencies may set more stringent effluent limits than those of the Federal Government. Under the US National Pollutant Discharge Elimination System (NPDES) Water quality based effluent limits may be established to maintain or improve the water quality of a receiving water body.

Ontario monthly average limits proposed for the parameters total suspended solids (25 mg/L) and oil and grease (13.0 to 15.0 mg/L) are more stringent than the new source performance standards established in the US. Monthly average Iron limits proposed for Ontario are comparable to the US limits. Ontario has not proposed a copper limit for chemical metal cleaning wastes because controlling total suspended solids and iron in these wastes will serve to control copper. Ontario has also not proposed limits for chlorine (free or total residual) added to cooling water for the purpose of controlling organisms and fouling because they are regulated under Ministry Certificates of Approval. The US has not established limits for aluminum, zinc ammonia plus ammonium, sulphide or phosphorus.

Table 5.37
U.S Environmental Protection Agency
Steam Electric Power Generation
New Source Performance Standards

CONSTITUENTS	WASTE STREAM	MAXIMUM FOR ANY ONE DAY (mg/l)	30 DAY AVERAGE (mg/l)
pH	All wastes except once-through cooling	6.0 - 9.0	6.0 - 9.0
Total Suspended Solids Note 1	Low volume wastes, Chemical Metal Cleaning, Bottom Ash Transport Water, Coal Pile Runoff	100 50	30 50
Oil & Grease	Low Volume Wastes, Chemical Metal Cleaning, Bottom Ash Transport Water	20	15
Free Available Chlorine Note 2	Once-through Cooling, Cooling Tower Blowdown	0.5	0.2
Total Residual Chlorine Note 2 Note 3	Once-through Cooling	0.2	0.2
Copper	Chemical Metal Cleaning,	1.0	1.0
Iron	Chemical Metal Cleaning,	1.0	1.0
Chromium	Cooling Tower Blowdown	0.2	0.2
Zinc	Cooling Tower Blowdown	1.0	1.0
126 Priority Pollutants	Cooling Tower Blowdown	Note 4	Note 4

NOTES:

1) Total Suspended Solids in the coal pile runoff should not exceed 50 mg/l at any one time.
2) Neither Free Available Chlorine nor Total Residual Chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge Free Available or Total Residual Chlorine for any one time.
3) Total Residual Chlorine in once-through cooling water is not to exceed a maximum concentraion of 0.2 mg/l.
4) The 126 Priority Pollutants shall not be at detectable levels.

Additional Items of Interest:
- Discharge of PCB's are prohibited.
- Low Volume Wastes include: wastewaters from wet scrubber equipment, ion exchange system, evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning waste and recirculating house service water system.
- Discharges of wastewater from fly ash transport water are prohibited.
- Information is taken from 40 CFR Part 423, Steam Electric Power Generation.

Table 5.38
U.S Environmental Protection Agency
Steam Electric Power Generation
Best Available Technology Standards

CONSTITUENTS	WASTE STREAM	MAXIMUM FOR ANY ONE DAY (mg/l)	30 DAY AVERAGE (mg/l)
Free Available Chlorine Note 2	Once-through Cooling, Cooling Tower Blowdown	0.5	0.2
Total Residual Chlorine Note 2 Note 3	Once-through Cooling	0.2	0.2
Copper	Chemical Metal Cleaning	1.0	1.0
Iron	Chemical Metal Cleaning	1.0	1.0
Chromium	Cooling Tower Blowdown	0.2	0.2
Zinc	Cooling Tower Blowdown	1.0	1.0
126 Priority Pollutants	Cooling Tower Blowdown	Note 4	Note 4

NOTES:

1) Total Suspended Solids in the coal pile runoff should not exceed 50 mg/l at any one time.
2) Neither Free Available Chlorine nor Total Residual Chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge Free Available or Total Residual Chlorine for any one time.
3) Total Residual Chlorine in once-through cooling water is not to exceed a maximum concentraion of 0.2 mg/l.
4) The 126 Priority Pollutants shall not be at detectable levels.

Additional Items of Interest:

- Discharge of PCB's are prohibited.
- Low Volume Wastes include: wastewaters from wet scrubber equipment, ion exchange system, evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning waste and recirculating house service water system.
- The 30 Day Average column refers to the averade of daily values for 30 consecutive days.
- The actual quantity of each parameter allowed in a particular waste stream is obtained by multiplying the concentration by the flow of the waste stream.
- Information is taken from 40 CFR Part 423, Steam Electric Power Generation.

Environment Canada Environmental Codes of Practice for Steam Electric Power Generation

The Environment Canada Design Codes of Practice for Steam Electric Power Generation contain recommended practices and design opportunities to reduce the discharge of contaminants from new or modified power generating stations. Appendix E of the Codes contains recommended effluent quality criteria that should be met for all process effluents before discharge to cooling water or directly to receiving waters. Concentration limits are specified for the ten parameters listed in table 5.39[4]. The effluent qualities are recommendations for new steam electric facilities or for systems which result from modifications to existing stations. They are not intended to apply to existing systems.

The effluent qualities recommended under the Environment Canada Codes of Practice are assessed based on seven day composite samples whereas compliance with the effluent limits proposed for Ontario will be assessed against daily maximum or monthly average concentrations (daily or weekly sampling). Due to the differences in sampling times the limits proposed for Ontario cannot be compared exactly to the effluent qualities recommended under the Environment Canada Codes of Practice. Roughly, the concentration limits proposed in Ontario for the parameters TSS and oil & grease are comparable to the effluent quality recommended by the Environment Canada Codes of Practice. With the exception of iron limits proposed by Ontario for radioactive liquid waste management system effluent which are less stringent than the codes, proposed iron limits are also comparable to the codes of practice. Ontario has proposed a zinc limit for radioactive liquid waste management system effluent which is comparable to the codes. A zinc limit is not proposed for other Ontario EPGS effluents because zinc was not found at levels treatable by the defined BAT. Ontario has also not proposed limits for the metals hexavalent chromium, total chromium, nickel, copper or total residual chlorine. These metals were not found in Ontario EPGS effluents at levels treatable by the defined BAT. Chlorine has been exempted from limits when added to cooling water for the purpose of controlling organisms and fouling. The Environment Canada Codes of Practice do not specify effluent quality recommendations for aluminum or phosphorus.

Table 5.39
Environment Canada Codes of Practice
Recommended Process Effluent Quality

Parameter	Recommended Effluent Quality	Units
pH	6.5 - 9.5	
TSS	≤ 25	mg/L
Oil & Grease	≤ 15	mg/L
Chromium (total)	≤ 0,5	mg/L
Chromium (hexavalent)	≤ 0.05	mg/L
Copper	≤ 0.5	mg/L
Nickel	≤ 0.5	mg/L
Zinc	≤ 0.5	mg/L
Iron	≤ 1.0	mg/L
Total Residual Chlorine	≤ 0.2	mg/L

Notes:
1) Metal concentrations are for total dissolved and undissolved solids.
2) Values apply to average weekly composite samples.

5.13 References

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2. Environment Ontario, Issues Resolution Process, Final Report Summary, September, 1991, ISBN 0-7729-8974-5

3. Ontario Hydro, A Review of Production Based Loadings at Ontario Hydro's Thermal Generating Stations, October 15, 1992, TOB-07293.

4. Environment Canada, Appendices: Environmental Codes of Practice for Steam Electric Power Generation - Design Phase, December 1986, Report EPS 1/PG/1A.

5. Bechtel Canada Inc., MISA Phase II Program - Best Available Technology Study, May 1992.

6. Letter from Ontario Hydro to MOEE re: Quench/Seal Effluent Loadings, August 25, 1993, TOB 07293 T3.

7. Environment Ontario, Candidate Substances List for Bans or Phase-outs, April 1992, ISBN 0-7729-9764-0, PIBS 1921E.

8. Ontario Ministry of Environment & Energy, Electric Power Generation Sector (EPGS) Draft Data Quality Evaluation Report,January 1993, (unpublished).

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10. Environment Ontario, Acute Lethality Data for Ontario's Electric Power Generation Sector Effluents Covering the Period from December 1990 to May 1991, December 1992, ISBN X-XXXX-XXXX-X, PIBS XXXX.

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12. Ontario Hydro Research Division, The Use of Humic Acid to Reduce the Toxicity of Boiler Blowdown Effluent, David W. Rodgers, February 23, 1993, Report No. G-93-2-K.

13. Letter from Ontario Hydro to MOEE re: EPGS Draft Limits

Regulation, May 30, 1994, NK - 07293.1.

14. Letter from Ontario Hydro to MOEE re: MISA EPGS Limit Setting Subcommittee Meeting Minutes - Action Item 940406-2 May 9, 1994.

15 Ontario Ministry of Environment and Energy, Procedure F-5-1 (formerly referenced by 08-01), Determination of Treatment Requirements for Municipal and Private Sewage Treatment Works Discharging to Surface Waters.

16 Ontario Ministry of Environment and Energy, Procedure F-5-2 (formerly referenced by 08-01), Relaxation of Normal Level of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters.

17 Ontario Ministry of Environment and Energy, Procedure F-5-3 (formerly referenced by 08-01), Derivation of Sewage Treatment Works Effluent Requirements for the Incorporation of Effluent Requirements into Certificates of Approval for New of Expanded Sewage Treatment Works.

18 Ontario Ministry of Environment and Energy, Procedure F-5-4 (formerly referenced by 08-01), Effluent Disinfection Requirements for Sewage Treatment Works Discharging to Surface Waters.

19 Ontario Ministry of Environment and Energy, Procedure F-8-1 (formerly referenced by 08-04), Determination of Phosphorus Removal Requirements for Municipal, Institutional and Private Sewage Treatment Works.

20 Ontario Ministry of Environment and Energy, Procedure F-10-1 (formerly referenced by 08-06), Procedures for Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only).

21 Canada - Ontario Agreement with respect to the Great Lakes Basin Ecosystem, July 6, 1994

Appendix to Section 5

Table I
Process Effluent Flow Versus Capacity and Average Daily Production Rates for Fossil Stations

Source: Ontario Hydro			Process Effluent Flow								
Stations	Capacity	Production	Ash Transport			Neutralization Sump			Ash Transport Only (less Neut. sump flow)		
	MW	MW-h/d *	m3/day	m3/d/MW	m3/d/MW-h/d	m3/day	m3/d/MW	m3/d/MW-h/d	m3/day	m3/d/MW	m3/d/MW-h/d
Lambton	2000	14600	2270	1.1	0.2	1750	0.9	0.12	520	0.3	0.04
Lakeview **	2100	10000	4900	2.3	0.5	1100	0.5	0.11	3800	1.8	0.38
Atikokan	215	2500	2200	10.2	0.9	170	0.8	0.07			
Thunder Bay	300	2500	2800	9.3	1.1	270	0.9	0.11			
Nanticoke	4100	36500	43600	10.6	1.2	850	0.2	0.02	42750	10.4	1.17
Lennox	2240	2070	N.A.	N.A.	N.A.	380	0.2	0.18			

Notes: * Average daily production over the MISA monitoring period.
** Unit 6 omitted from estimate of total capacity due to extended outage for rehabilitation.

Table II
Process Effluent Flow Versus Capacity and Average Daily Production Rates for Nuclear Stations

Source: Ontario Hydro			Process Effluent Flow					
Stations	Capacity	Production	Radioactive Liquid Waste Management			Neutralization Sump		
	MW	MW-h/d	m3/day	m3/d/MW	m3/d/MW-h/d	m3/day	m3/d/MW	m3/d/MW-h/d
Bruce-A	3056	41,700	174	18	240	880	3.5	47
Bruce-B	3345	66,900	77.6	43	862	563	5.9	119
Darlington	3524		83.5			320		
Pickering	4120	61,500	429	9.6	143	972	4.2	63

Table A
Selection of Parameters for Limits

Fossil Stations: Ash Transport Water Treatment System Effluent Streams

ATG	Parameter	Rationale for Exclusion or Retention
1	COD	BAT not identified. Petroleum Guideline of 200mg/L not exceeded. Insufficient data: sampled quarterly - EXCLUDED
2	Cyanide	Unique parameter found at 1 site. Low concentration. BAT not identified. -EXCLUDED
4a	Ammonia plus ammonium	BAT not identified. No exceedances above Provincial Guidelines of 10mg/L. Only found at Nanticoke and system there is now modified to a "dry" fly ash system.-EXCLUDED
	TKN	BAT not identified. Questionable/low value data. BAT not identified.-EXCLUDED
4b	Nitrate + Nitrite	Found at 3 sites. No BAT identified.- EXCLUDED
5a	DOC	BAT not identified. Found at all sites. Related to COD. No Provincial Guideline.-EXCLUDED
5b	TOC	BAT not identified. Found at two sites. EXCLUDED
6	Total Phosphorus	BAT not identified. Found at low or questionable levels - EXCLUDED
8	**Total Suspended Solids**	Found at all sites. Clarification/sedimentation followed by filtration can control this parameter and is identified BAT for the sector.-INCLUDED
9	**Aluminum**	BAT not identified. However, aluminum is present in coal ash / coal and therefore this parameter is INCLUDED
	Boron	BAT not identified. One site had low data while another was questionable.- EXCLUDED
	Cadmium	BAT not identified. Very low data. Data rejected at one site based on QC analysis.- EXCLUDED
	Chromium	BAT not identified. Found at one site only at low levels. - EXCLUDED
	Copper	Low level at most sites. Included because physical chemical treatment can control this parameter. Also a codes of practice parameter. - INCLUDED
	Lithium	BAT not identified. Low value data: found at two sites only. - EXCLUDED

(Continued)

Table A (contd.)

ATG	Parameter	Rationale for Exclusion or Retention
	Molybdenum	BAT not identified. Low value data at two sites only. - EXCLUDED
	Nickel	BAT not identified. Low value data at two sites only. - EXCLUDED
	Strontium	BAT not identified. Found at all sites. - EXCLUDED
	Vanadium	BAT not identified. Found at one site which has since been modified. Out dated data. - EXCLUDED
	Zinc	Codes of Practice Parameter. Found at low levels. ??
9a	Iron	Codes of practice parameter. Treatable by physical chemical treatment. Found above code value of 1 ppm. - INCLUDED
10	Antimony	BAT not identified. Unique to one site.-EXCLUDED
	Arsenic	BAT not identified. Unique to one site and questionable data.- EXCLUDED
	Selenium	BAT not identified. Unique to one site and system changed to "dry" fly ash. - EXCLUDED
11	Chromium(Hex.)	BAT not identified. Unique to one site. Low value.- EXCLUDED
12	Mercury	BAT not identified. Found at two sites. Bans or Phase Outs Parameter.-EXCLUDED
14	Phenolics	BAT not identified. Questionable data due to high values in intake and sampler contamination problems.
16	Bromodichloro-methane	BAT not identified. Unique to one site and low value.- EXCLUDED
	Chloroform	BAT not identified. Found at two sites. - EXCLUDED
	Methylene chloride	Found at one site and questionable at one. BAT not identified. -EXCLUDED
	Trichloro-fluoromethane	Questionable data at one site only. EXCLUDED
17	Toluene	Unique at one site only. BAT not identified.-EXCLUDED
25	Oil and Grease	BAT not identified. Found at all sites except Lakeview. Low levels at Nanticoke.- EXCLUDED

Table B
Selection of Parameters for Limits

Fossil Stations: Neutralization Sump Effluent Streams

ATG	Parameter	Rationale for Exclusion or Retention
1	COD	BAT not identified. Petroleum Guideline of 200mg/L not exceeded. Insufficient data: sampled quarterly - EXCLUDED
4a	Ammonia plus ammonium	BAT not identified. No exceedances above Provincial Water Quality Guidelines of 10mg/L in neutralization sumps. Also low/unreliable (at Atikokan) data - EXCLUDED
	TKN	BAT not identified. Low value data (0.9 to 2.5 mg/L. - EXCLUDED
4b	Nitrate + Nitrite	No BAT identified. Low value data (0.2 to 0.8 mg/L) - EXCLUDED
5a	DOC	BAT not identified. Found at all sites. Related to COD. No Provincial Guideline for DOC.-EXCLUDED
5b	TOC	BAT not identified. Low at one of three sites. - EXCLUDED
6	Total Phosphorus	BAT not identified. Unreliable at two sites and low or questionable levels - EXCLUDED.
8	**Total Suspended Solids**	Found at all sites. Clarification/sedimentation followed by filtration can control this parameter and is identified BAT for the sector. Low at Lennox TGS - INCLUDED
9	**Aluminum**	BAT not identified. Iron is placed in the same group as Aluminum by the BAT Consultant and therefore its control should also control Aluminum. However, where alum is used, this parameter will be INCLUDED
	Boron	BAT not identified. Low data: 1 to 3 RMDL.- EXCLUDED
	Cadmium	BAT not identified. Very low data : LTA less than 2 RMDL. -EXCLUDED
	Chromium	BAT not identified. Found at two sites only at close to RMDL levels. - EXCLUDED
	Copper	Low untreatable level at all sites (2 to 8 RMDL). Included because physical chemical treatment can control this parameter. Also a codes of practice parameter. - INCLUDED

(Continued)

Table B (contd.)

ATG	Parameter	Rationale for Exclusion or Retention
	Lead	BAT not identified. Very low data around RMDL. - EXCLUDED
	Molybdenum	BAT not identified. Identified at two sites only. - EXCLUDED
	Nickel	BAT not identified. Questionable low data. Frequency of detection low: about 22% - EXCLUDED
	Strontium	BAT not identified. Although found at all sites: also high in intakes. BAT Consultant selected Iron to control Strontium. - EXCLUDED
	Zinc	Low untreatable levels found. However Codes of Practice Parameter.
9a	**Iron**	Codes of practice parameter. Treatable by physical chemical treatment. Found above code value of 1 ppm. - INCLUDED
12	Mercury	BAT not identified. Found at three sites. **Bans or Phase Outs Parameter.**-EXCLUDED
14	Phenolics	BAT not identified. Rejected data. Questionable data due to high values in intake and sampler contamination problems. - EXCLUDED
15	Sulphide	BAT not identified. Unique parameter found at 0.09 mg/L at Lennox TGS only. - EXCLUDED
16	Chloroform	BAT not identified. Found at two sites. - EXCLUDED
25	Oil and Grease	BAT not identified. Found at close to RMDL's -EXCLUDED

Table C
Selection of Parameters for Limits
Fossil Stations: Oily Water Separator Effluent Streams

ATG	Parameter	Rationale for Exclusion or Retention
1	COD	BAT not identified. Petroleum Guideline of 200mg/L not exceeded. LTA's range from 14 - 35 mg/L. Insufficient data: sampled quarterly - EXCLUDED
4a	Ammonia plus ammonium	BAT not identified. Unique parameter at one site and rejected due to QA concerns. - EXCLUDED
	TKN	BAT not identified. Very low value data (0.5 to 1.4 mg/L.) - EXCLUDED
4b	Nitrate + Nitrite	No BAT identified. Very low value data (0.3 to 0.4 mg/L) - EXCLUDED
5a	**DOC**	BAT not identified. Found at all sites. Related to COD. No Provincial Guideline for DOC.-Could serve as an alternate to Oil and Grease
5b	TOC	BAT not identified. Low at all sites : less than 2 RMDL. - EXCLUDED
6	Total Phosphorus	BAT not identified. Unreliable at two sites and low or questionable levels - EXCLUDED.
8	**Total Suspended Solids**	Found at two sites. Clarification/sedimentation followed by filtration can control this parameter and is identified BAT for the sector. Low at Lennox TGS - INCLUDED
9	Aluminum	BAT not identified. Iron is placed in the same group as Aluminum by the BAT Consultant and therefore its control should also control Aluminum. No guidelines available.- EXCLUDED
	Cadmium	BAT not identified. Very low data at two sites only : LTA's less than 1.5 RMDL. - EXCLUDED
	Copper	Low untreatable level at all sites (less than 3.5 RMDL). Excluded because BAT not identified.

(Continued)

Table C (contd.)

ATG	Parameter	Rationale for Exclusion or Retention
	Molybdenum	BAT not identified. Unique to one site at 4 RMDL: untreatable - EXCLUDED
	Nickel	BAT not identified. Unique to one site at 1 RMDL - EXCLUDED
	Strontium	BAT not identified. Although found at all sites: also high in intakes. BAT Consultant selected Iron to control Strontium. - EXCLUDED
	Zinc	Low untreatable levels found. However Codes of Practice Parameter.
9a	**Iron**	Codes of practice parameter. Treatable by physical chemical treatment. Found below code value of 1 ppm.
14	Phenolics	BAT not identified. Rejected data at two sites. Questionable data due to high values in intake and sampler contamination problems. - EXCLUDED
16	1,1 Dichloroethane	BAT not identified. Unique parameter found at 0.7 to 1.7 ug/L at Lakeview TGS only. - EXCLUDED
	Chloroform	BAT not identified. Questionable/low data. - EXCLUDED
	Methylene chloride	BAT not identified. Found at two out of four sites: rejected/questionable data. - EXCLUDED
	Trichloro-fluoromethane	BAT not identified. Unique to one site: rejected data.
19	Bis(2ethylhexyl) phthalate	BAT not identified. Questionable data found at one site only and low levels. - EXCLUDED
25	**Oil and Grease**	BAT identified. Primary parameter for limits - INCLUDED
27	PCBT	BAT not identified: Unique to Lakeview: 3/4 found - Excluded

Table D
Selection of Parameters for Limits

Fossil Stations: Coal Pile Effluent Streams Pg. 1 of 2

ATG	Parameter	Rationale for Exclusion or Retention
1	COD	BAT not identified. Petroleum Guideline of 200mg/L not exceeded. Unique parameter found at one site only. Insufficient data: sampled quarterly - EXCLUDED
4a	Ammonia plus ammonium	BAT not identified. No LTA exceedances above Provincial Guidelines of 10mg/L. Found at two stations and data at one of them was rejected due to QA concerns. - EXCLUDED
	TKN	BAT not identified. Found at two sites. Low value data. -EXCLUDED
4b	Nitrate + Nitrite	BAT not identified. Found at 1 site. Low value data. - EXCLUDED
5a	DOC	BAT not identified. Found at all sites. Related to COD. No Provincial Guideline. - EXCLUDED
5b	TOC	BAT not identified. Unique to one site. Insufficient data: sampled quarterly. - EXCLUDED
6	Total Phosphorus	BAT not identified. Found at low or questionable levels at two sites - EXCLUDED
8	**Total Suspended Solids**	Found at all sites. Clarification/sedimentation followed by filtration can control this parameter and is identified BAT for the sector.-INCLUDED
9	**Aluminum**	BAT not identified. Control of Iron will control aluminum according to the BAT consultant - However, INCLUDED because aluminum present in coal.
	Boron	BAT not identified. Found at levels of 0.7 to 13.9 mg/L - EXCLUDED
	Cadmium	BAT not identified. Very low value data (untreatable levels): close to RMDL. - EXCLUDED
	Copper	Low level at most sites. Included because physical chemical treatment can control this parameter. Also a codes of practice parameter. - INCLUDED
	Lithium	BAT not identified. Found at two sites only: questionable data at one of these sites. - EXCLUDED

Table D (contd.)

ATG	Parameter	Rationale for Exclusion or Retention
	Molybdenum	BAT not identified. Low value data at one of two sites. - EXCLUDED
	Nickel	BAT not identified. Low value data: untreatable levels found at two sites only. - EXCLUDED
	Strontium	BAT not identified. Found at all sites. - EXCLUDED
	Zinc	BAT not identified. Codes of Practice Parameter. Found at low levels with data rejected at one site out of three monitored. - EXCLUDED
9a	**Iron**	Codes of practice parameter. Treatable by physical chemical treatment. Found above code value of 1 ppm. - INCLUDED
11	Chromium(Hex.)	BAT not identified. Unique to one site. Low value: 32 ug/L.- EXCLUDED
12	Mercury	BAT not identified. Found at one site. Bans or Phase Outs Parameter.-EXCLUDED
14	Phenolics	BAT not identified. QA rejected data due to high values in intake and sampler contamination problems.
25	**Oil and Grease**	BAT not identified. Found at all sites. Exceeds Codes of Practice value of 15 mg/L. Also oil is spread on Lakeview coal pile as dust suppressant. - INCLUDED.

TABLE E
SELECTION OF PRIORITY 1 PARAMETERS FOR LIMITS
NUCLEAR STATIONS: RLWMS EFFLUENT

ATG	Parameter	Rationale for Exclusion or Retention
1	COD	BAT not identified. Petroleum Sector guideline of 200 mg/l not exceeded. Sampled quarterly and maximum level detected was 160 mg/l at Darlington - Exclude from limits.
4a	Ammonia plus ammonium	Found at all nuclear stations . Maximum level detected: 4.5 mg/l. Most samples detected low levels compared to PWQO of 10 mg/l. Loadings also low: 0.3 - 0.42 kg/d. - Exclude from limits.
4b	Nitrate + Nitrite	Found at low levels with maximum of 3.2 RMDL (0.25mg/l). These levels are well below Maximum Acceptable Concentrations for drinking water of 10 mg/l. No BAT identified. Exclude from limits.
	Total Kjeldahl Nitrogen	BAT not identified. Levels are low. LTA's vary from 0.7 to 4.4 mg/l. Exclude from limits.
5a	DOC	Found at all station RLWMS effluent. Darlington data precision is questionable. No provincial guideline established and BAT not identified. Exclude from limits.
5b	TOC	Found at all station RLWMS effluent. BAT not identified. Mean concentrations vary from 12 mg/l to 26 mg/l and loadings from .8 kg/day to 6.7 kg/day. Exclude from limits.
6	**Total Phosphorus**	Found at all stations exceeding provincial industrial discharge objectives of 1mg/l. Although no BAT was identified source control can be used to meet limits. eg. substitute phosphorus free detergents used at the stations. **Include for limits.**
8	**Total Suspended Solids**	Found at all sites at mean levels varying from 6.9 mg/l to 40 mg/l with industrial discharge objectives of 15 mg/l being exceeded at all sites. This is a key sector parameter and is included for limits.
	Volatile Suspended Solids	Only 5 samples were collected at Darlington and VSS was detected in three of those samples at a mean level of 13 mg/l. Total suspended solids limits should control VSS - Exclude from limits.
9	Aluminum	BAT not identified in study. Found at 0.088 to 0.6 mg/l. Exclude from limits
	Boron	Demonstrated BAT not identified. Only found at two sites: 0.08 to 0.170 mg/l. Exclude from limits.
	Cadmium	Bechtel Canada reported an achievable effluent quality of 100 ug/l using alkali precipitation or sulphide precipitation. Levels found between 2.6 to 5.1 ug/l are well below this treatable quality. Exclude from limits.
	Copper	Untreatable levels detected: 31 to 150 ug/l mean values. Exclude from limits.
	Lithium	Untreatable levels detected at three out of four stations. Means range from 58 to 120 ug/l. Exclude from limits.
	Molybdenum	Found only at one site (Bruce B) with 9th decile of data less than 75 ug/l. Exclude from limits.
	Nickel	Found at Pickering only. BAT achievable levels are 500 ug/l while maximum detected was 60 ug/l. Exclude from limits.
	Strontium	BAT not identified. Found at all sites. Exclude from limits.
	Zinc	Found at all sites. Maximum concentration range from 950 to 3000 ug/l. Include for limits.
9a	Iron	Found at all sites. Means range from 0.48 to 2.1 mg/l. Key representative sector parameter. Include for limits.

TABLE E (continued)

ATG	Parameter	Rationale for Exclusion or Retention
12	Mercury	Found at two stations, Bruce A & B. Maximum concentration range: 1.6 to 3.7 ug/l. Bans or Phase Outs parameter. BAT not identified. Exclude from limits.
14	Phenolics(4AAP)	Found at Bruce A and Darlington. Maximum concentration ranged from 12 to 16 ug/l. No BAT identified at these levels. Exclude from limits.
15	Sulphide	Found at Bruce A only. 9th Decile concentration was 0.25 mg/L BAT not identified. Exclude from limits.
16	1,4-Dichlorobenzene	Maximum concentration found was 2.4 ug/l which is 1.4 RMDL. Detected only at Darlington in 4/14 samples analyzed. BAT not identified. US Organic Sector limits this parameter at 380 ug/l (non-biological daily effluent limit)
	Chloroform	Found at all stations at mean levels of 1.8 to 10 ug/l. BAT not identified. Potential source is laboratory drains. Can be controlled by BMP's. Exclude from limits.
	Methylene chloride	Found at three of the four stations at mean levels of 16 to 280 ug/l. This parameter is a common laboratory solvent and can easily contaminate samples being analyzed. No BAT identified. US Organic Sector limits for non-biological daily effluent limit is 170 ug/l. Although concentrations found are high, the loadings are low (0.015 to 0.12 kg/g). Exclude from limits.
	Tetrachloroethylene	Found only at Bruce A. Mean of 17 ug/l was detected with a maximum of 60 ug/l. The US Organic Sector non-biological effluent daily limit is 164 ug/l. Loadings are low: 0.003 kg/d. No BAT identified. Exclude from limits.
17	m-Xylene and p-Xylene	Found at Darlington only in 3 out of 5 samples. Low level contamination of travelling blanks (1.7 RMDL) suggests over-estimation of these low level detects (LTA = 3.2 ug/l). No BAT identified. Exclude from limits.
	o-Xylene	Found (LTA = 1.7 ug/l) at Darlington only in 3/5 samples. Two duplicates reported showed poor agreement. No BAT identified. Exclude from limits.
19	Benzyl-butyl-phthalate	Found at Darlington only in 3/5 samples. Questionable data. LTA = 5 ug/l. Exclude from limits.
	Bis(2-ethylhexyl) phthalate	Found at three of the four stations. LTA vary from 15 to 340 ug/l. Limited number of samples taken (quarterly). Non-biological daily effluent limit for US Organic Sector is 258 ug/l. No BAT identified. Exclude from limits.
23	1,2,3-Trichlorobenzene	Found at Darlington only in 6/13 samples. LTA = 0.011. Maximum concentration was 2.4 RMDL (0.01 ug/l) and therefore data is qualitative and not acceptable for limits.
	1,2,4-Trichlorobenzene	Found at Darlington only in 8/13 samples. LTA = 0.031. The US Organic Sector non-biological daily effluent limits are 794 ug/l. No BAT identified. Exclude from limits.
24	Octachlorodibenzo-p-dioxin	Found at three of the four stations. LTAs varied from 0.081 to 0.324 ng/l. Bans or Phase Outs Parameter. No BAT available. Exclude from limits.
25	Oil & Grease	Found at all stations. LTAs vary from 1.9 to 11 mg/l. Maximum concentrations vary from 8.9 to 120 mg/l. Include for limits.
27	Polychlorinated biphenyls	Found at Bruce A and Pickering in 29/52 and 40/50 samples respectively. LTAs vary from 0.18 to 0.28 ug/l with maximums from 1.6 to 2 ug/l. PCB containing equipment is in service at Bruce A & Pickering. QA/QC assessment of data confirmed their validity, however, based on spiked travelling blank over-recoveries, the data may be over estimated. Bans or Phase Outs parameter. Ontario Hydro investigating sources and remedial action. Exclude from limits since no BAT identified.

TABLE F
SELECTION OF PRIORITY 1 PARAMETERS FOR LIMITS
NUCLEAR STATIONS: Water Treatment Plant Effluent

ATG	Parameter	Rationale for Exclusion or Retention
1	COD	Found at three stations. BAT not identified. Petroleum Sector guideline of 200 mg/l not exceeded. Sampled quarterly and maximum level detected was 52 mg/l at Bruce-B - Exclude from limits.
2	Cyanide Total	Found at Darlington only. No BAT identified. No known sources of cyanide. Detected in 4/5 samples with maximum concentration of 0.03 mg/l. Exclude from limits.
4a	Ammonia plus ammonium	Found at two nuclear stations . Maximum level detected: 2.1 mg/l. All samples detected low levels compared to PWQO of 10 mg/l. Loadings also low: 0.1 - 0.3 kg/d. - Exclude from limits.
4b	Nitrate + Nitrite	Found at all stations with 9th decile maximum of 4.7 mg/l. These levels are well below Maximum Acceptable Concentrations for drinking water of 10 mg/l. No BAT identified. Exclude from limits.
	Total Kjeldahl Nitrogen	BAT not identified. Levels are low. LTA's vary from 0.59 to 1.4 mg/l. Exclude from limits.
5a	DOC	Found at all station WTP effluent (LTA: 6.3 to 9.7 mg/l). No provincial guideline established and BAT not identified. Potential sources are trace impurities in regenerant chemicals and oil leaks from pumps. Exclude from limits.
5b	TOC	Found at three station WTP effluent (LTA: 8.8 to 24 mg/l). BAT not identified. Loadings vary from 3.4 kg/day to 16 kg/day. Oil & Grease limit will represent this parameter. Exclude from limits.
6	Total Phosphorus	Found at Bruce A & Bruce B. BAT not identified. LTAs: Maximum - 0.2 to 0.8 mg/l. Exclude from limits.
8	**Total Suspended Solids**	Found at Bruce B & Pickering at mean levels varying from 20 mg/l to 150 mg/l with industrial discharge objectives of 15 mg/l being exceeded. This is a key sector parameter and is included for limits.
	Volatile Suspended Solids	Only 4 samples were collected at Bruce B and VSS was detected in three of those samples at a mean level of 37 mg/l. Total suspended solids limits should control VSS - Exclude from limits.
9	Aluminum	BAT not identified in study. Found at 84 to 25000 ug/l. The high concentration of this parameter is because at Bruce B after alum addition, clarifier underflow and filter backwash are discharged through the neutralization sump. Include for limits.
	Boron	Demonstrated BAT not identified. Found at all stations: 69 to 180 ug/l. Exclude from limits.
	Cadmium	Bechtel Canada reported an achievable effluent quality of 100 ug/l using alkali precipitation or sulphide precipitation. Levels found between 2. to 3.9 ug/l are well below this treatable quality. Exclude from limits.
	Chromium	Found at Bruce B only. BAT can reduce levels to 500 ug/l monthly average. However, 9/51 samples in which the parameter was detected, levels were low with a maximum concentration of 98 ug/l (9th Decile : 26 ug/l). Exclude from limits.
	Copper	Found at all stations at untreatable levels: 11 to 27 ug/l mean values. Exclude from limits.

TABLE F (continued)

ATG	Parameter	Rationale for Exclusion or Retention
9	Lithium	Found at Darlington only in 4/13 samples at untreatable levels: LTA = 35 ug/l. Exclude from limits.
	Molybdenum	Found at three stations at LTA range of 18 to 72 ug/l. BAT not identified. Exclude from limits.
	Nickel	Found at three stations. BAT not identified for low levels found. LTA range: 22 to 34 ug/l. Environment Canada Codes require a level of 500 ug/l. Exclude from limits.
	Strontium	Found at all stations at mean concentrations of 450 to 810 ug/l. Intake water concentrations also high. No BAT identified. Exclude from limits.
	Zinc	Found at all stations at mean concentrations of 8.2 to 46 ug/l. Environment Canada Codes require a level of 500 ug/l achievable by alkali treatment. Exclude from limits.
9a	Iron	Found at all stations at mean concentrations of 190 to 970 ug/l. Environment Canada Codes require a level of 1000 ug/l weekly composite average. These were exceeded at all except Bruce A. Include this key parameter for limits.
12	Mercury	Found at two stations, Bruce A & Darlington. Maximum concentration range: 0.13 to 0.42 ug/l. Bans or Phase Outs parameter. BAT not identified. Exclude from limits.
14	Phenolics(4AAP)	Found at Darlington only. Maximum concentration : 87 ug/l. No BAT identified at these levels. Data considered unreliable due to possible auto-sampler contamination. Exclude from limits.
16	Bromodichloromethane	Found at three stations. Maximum concentration found was 3.4 to 6.5 ug/l which is less than 8 RMDL (0.8 ug/l). No BAT identified. Potentially formed during chlorination of water. Exclude from limits
	Dibromochloromethane	Found at Bruce A & B at very low levels : less than 2.5 RMDL (1.1 ug/l). No BAT identified. Exclude from limits.
	Chloroform	Found at three stations at mean levels of 2.9 to 12 ug/l. BAT not identified. Potential source is laboratory drains and chlorination of water. Can be reduced by BMP's. Exclude from limits.
25	Oil & Grease	Found at Bruce B & Pickering. LTAs vary from 1.2 to 1.8 mg/l. Maximum concentrations vary from 5.2 to 18 mg/l. Exclude from limits.

TABLE G
SELECTION OF PRIORITY 1 PARAMETERS FOR LIMITS
NUCLEAR ASSOCIATED FACILITIES: Heavy Water Plant Effluent

ATG	Parameter	Control Points	Rationale for Exclusion or Retention
1	COD	PR 0400	BAT not identified. Petroleum Sector guideline of 200 mg/l not exceeded. Detected in 3/3 samples at maximum level of 27 mg/l. Exclude from limits.
4b	Nitrate + Nitrite	PR 0400 PR 0500	Concentrations measured at 0.46 to 1.8 mg/l (maximum) are well below Maximum Acceptable Concentrations for drinking water of 10 mg/l. No BAT identified. Exclude from limits.
	Total Kjeldahl Nitrogen	PR 0400	BAT not identified. Levels are low and maximum concentration detected is 2 RMDL. Exclude from limits.
5a	DOC	PR 0400 PR 0500	No provincial guideline established and BAT not identified. Potential sources are oil leaks from pumps & hydrogen sulphide blowers. Exclude from limits.
5b	TOC	PR 0400	BAT not identified. Detected in 3/4 samples at 6.8 mg/l maximum. Exclude from limits.
8	Total Suspended Solids	PR 0400	Detected in 4/14 samples at maximum level of 33 mg/l. There is no source of suspended solids from the process operations and therefore exclude from limits.
9	Aluminum	PR 0400 PR 0500	BAT not identified in study. Found at 220 to 400 ug/l maximum levels. Levels comparable to intake levels and process not contributing to these levels. Exclude from limits.
	Strontium	PR 0400 PR 0500	Levels similar to intake water levels. Found at 160 to 220 ug/l maximum concentration levels. No BAT identified. Exclude from limits.
	Zinc	PR 0400 PR 0500	Found at low maximum levels of 48 and 70 ug/l respectively. Untreatable levels of detection. Exclude from limits.
9a	Iron	PR 0400 PR 0500	Elevated levels of this parameter were detected in PR 0400 in 3/3 samples. Maximum concentration of 960 ug/l. However, there is insufficient data to set limits.
14	Phenolics	PR 0500	Detected in 4/12 samples at 4 ug/l maximum concentration. Untreatable levels. Exclude from limits.
15	Sulphide	PR 0500 PR 0400	This is the key process parameter and was detected 102/361 samples in PR 0500. Although no BAT was identified, this is a unique BAT plant and performance values on effluent can be used as limits.
19	Bis(2-ethylhexyl) phthalate	PR 0400	Found in 2/3 samples at 9.3 ug/l maximum concentration. No BAT identified. Exclude from limits.
25	Solvent Extractables	PR 0400 PR 0500	Found at maximum levels of 3.6 to 6 mg/l respectively. Levels too low to treat further by oily water separators. No other BAT identified. Exclude from limits.

PR 0400: Process Effluent Lagoon Effluent
PR 0500: Process Effluent

TABLE H
SELECTION OF PRIORITY 1 PARAMETERS FOR LIMITS
NUCLEAR ASSOCIATED FACILITIES: Sewage Treatment Plants at Darlington & BNPD

ATG	Parameter	Control Points	Rationale for Exclusion or Retention
1	COD	PR 0100 PR 0800	BAT not identified. Petroleum Sector guideline of 200 mg/l not exceeded. Detected in 4/4 samples at maximum levels of 18 to 67 mg/l. Exclude from limits.
1a	**BOD_5**	PR 0100 PR 0800	Not monitored but will be limited at 25 mg/l per MOEE Policy and as per LSS agreement.
2	Cyanide Total	PR 0800	Found at Darlington in 4/4 samples at 0.038 mg/l maximum. No BAT identified. Exclude from limits.
4a	**Ammonia + ammonium**	PR 0100 PR 0800	Found at both sites at average concentrations of 1.9 to 3.4 mg/l. BAT not identified. Municipal STP's in Ontario with secondary treatment discharge an average of 4 mg/l. LSS agreed that limits should be placed reflecting current performance as no nitrification is not practiced.
	Total Kjeldahl Nitrogen	PR 0100 PR 0800	Found at both sites at maximum concentrations of 11 to 15 mg/l. No BAT identified. Exclude from limits.
4b	Nitrate + Nitrite	PR 0100 PR 0800	Concentrations measured at 12 to 29 mg/l (maximum) are above Maximum Acceptable Concentrations for drinking water of 10 mg/l. No BAT identified. Exclude from limits.
5a	DOC	PR 0100 PR 0800	No provincial guideline established and BAT not identified. Found at 13 to 17 mg/l maximum concentration. BOD_5 control will act as a surrogate. Exclude from limits.
5b	TOC	PR 0800	BAT not identified. Detected at Darlington only at average concentration of 13 mg/l. BOD5 control will act as surrogate. Exclude from limits.
6	Total Phosphorus	PR 0100 PR 0800	Phosphorus is controlled at PR 0100 by alum addition but not at PR 0800. LSS agreed to a limit of 1 mg/l TP based on industrial discharge guidelines for PR 0100. PR 0800 will be limited at its performance level because TP loading discharged < 4.54 kg/d.
8	**Total Suspended Solids**	PR 0100 PR 0800	Detected in 210/363 and 348/357 samples at 9th decile levels of 11 mg/l and 25 mg/l respectively. No BAT was identified for this parameter and therefore limits were set based on individual performance.
	Volatile Suspended Solids	PR 0800	Found at Darlington in 92/151 samples at average level of 13 mg/l. TSS will control VSS - Exclude from limits.
9	Aluminum	PR 0100 PR 0800	BAT not identified in study. Found at 190 to 600 ug/l average concentration levels. Alum addition for removal of Phosphorus contributes to the presence in PR 0100. LSS agreed to exclude from limits as MOEE Policy does not generally control this parameter in STP discharges.
	Boron	PR 0100	Found at 79 to 140 ug/l maximum concentration levels at BNPD only. No BAT identified. Exclude from limits.
	Cadmium	PR 0800	Found at very low levels in 5/12 samples: 2.7 (average) to 6.2 (maximum) ug/l. No BAT identified at these low levels. Exclude from limits.

TABLE H (continued)
SELECTION OF PRIORITY 1 PARAMETERS FOR LIMITS
NUCLEAR ASSOCIATED FACILITIES: Sewage Treatment Plants at Darlington & BNPD

ATG	Parameter	Control Point	Rationale for Exclusion or Retention
9	Copper	PR 0100 PR 0800	Found at 31 to 35 ug/l: well below BAT treatable levels. Exclude copper from limits.
	Strontium	PR 0100 PR 0800	Found in both streams at mean concentrations of 210 to 590 ug/l. Intake water concentrations also high. No BAT identified. Exclude from limits.
	Zinc	PR 0100 PR 0800	Found in both effluent at mean concentrations of 61 to 82 ug/l: well below identified BAT levels. Exclude from limits.
9a	Iron	PR 0100 PR 0800	Found at 93 to 390 ug/l average concentration levels. BAT not identified for these effluent. Exclude from limits.
10	Antimony	PR 0800	Found at Darlington only at low levels in 4/12 samples at 3.1 ug/l average concentration. No BAT identified. Exclude from limits.
12	Mercury	PR 0800	Found at Darlington only at 2.2 ug/l maximum concentration. No BAT identified. A Bans or Phase out parameter. Exclude from limit.
14	Phenolics (4AAP)	PR 0100 PR 0800	No BAT identified. QA/QC analysis indicated all phenolics data to be suspect particularly because of possible contamination from auto-sampler tubing. Exclude from limits.
16	Bromodichloromethane	PR 0100 PR 0800	Found at both stations. Maximum concentration found was 1.2 to 2.6 ug/l which is less than 3.3 RMDL (0.8 ug/l). No BAT identified. Potentially formed during chlorination of water. Exclude from limits
	Chloroform	PR 0100 PR 0800	Found at both stations at mean levels of 5.1 to 12 ug/l. BAT not identified. Potential source is laboratory drains and chlorination of water. Can be reduced by BMP's. Exclude from limits.
	Dibromochloromethane	PR 0800	Found at Darlington only at mean level of 1.1 ug/l (2 ug/l at 9th. decile). No BAT identified. Exclude from limits.
17	Toluene	PR 0800	Found at Darlington only at mean level of 0.33 ug/l in 14/52 samples. No BAT identified. Exclude from limits.
19	Bis(2-ethylhexyl) phthalate	PR 0800	Found at Darlington only at maximum level of 22 ug/l in 2/3 samples. No BAT identified. Exclude from limits.
25	**Oil and Grease**	PR 0800	Found at Darlington only at 4.1 mg/l average and 8.5 mg/l 9th decile concentrations in 80/149 samples. LSS agreed to set limit based on Darlington performance data.
31	Total Residual Oxidants	PR 0100 PR 0800	Found at both sites at mean levels of 0.77 to 1 mg/l. Parameter measures residual chlorine and other oxidants. The LSS agreed to exclude TRO from limits because a non-toxic effluent is also a requirement of the regulation.

PR 0100: BNPD Sewage Treatment Plant Effluent
PR 0800: Darlington Sewage Treatment Plant Effluent
LSS : Limit Setting Subcommittee

TABLE I
SELECTION OF PRIORITY 1 PARAMETERS FOR LIMITS
NUCLEAR STATIONS: Oily Water Separator Effluent

ATG	Parameter	Rationale for Exclusion or Retention
1	COD	Found at one station only. BAT not identified. Petroleum Sector guideline of 200 mg/l not exceeded. Event discharge sampled quarterly and maximum level detected was 33 mg/l at Darlington - Exclude from limits.
2	Cyanide Total	Found at Darlington only. No BAT identified. No known sources of cyanide. Detected in 3/4 samples with maximum concentration of 0.03 mg/l. Exclude from limits.
4a	Ammonia plus ammonium	Found at Darlington nuclear station only . Maximum level detected: 0.5 mg/l. All samples detected low levels (less than 2 RMDL) compared to PWQO of 10 mg/l. - BAT not identified. Exclude from limits.
4b	Total Kjeldahl Nitrogen	BAT not identified. Found at two stations. LTA's vary from 0.62 mg/l at Pickering to 129 mg/l at Darlington. Exclude from limits.
5a	DOC	Found at both stations (Maximum concentrations: 3.53 mg/l to 16.6 mg/l). No provincial guideline established and BAT not identified. Exclude from limits.
5b	TOC	Found at Darlington at maximum concentration of 12.7 mg/l. BAT not identified. Loadings very low. Oil & Grease limit will represent this parameter. Exclude from limits.
6	Total Phosphorus	Found at Darlington at 0.5 mg/l maximum. BAT not identified. Exclude from limits.
8	Total Suspended Solids	Found at Darlington at mean level of 6.14 mg/l with industrial discharge objectives of 15 mg/l not being exceeded. Although this is a key sector parameter, physical separation of oil from water is not BAT for control of TSS. Exclude from limits.
9	Aluminum	BAT not identified in study. Found at both sites at average levels of 54 to 104 ug/l. Exclude from limits.
	Cadmium	Bechtel Canada reported an achievable effluent quality of 100 ug/l using alkali precipitation or sulphide precipitation. Level found: 2.6 ug/l average and 3.8 ug/l maximum at Darlington is well below the treatable quality. Exclude from limits.
	Copper	Found at Darlington at untreatable level: 36 ug/l maximum value. Exclude from limits.

TABLE I (continued)

ATG	Parameter	Rationale for Exclusion or Retention
	Strontium	Found at both stations at mean concentrations of 54 to 268 ug/l. Intake water concentrations also high. No BAT identified. Exclude from limits.
	Zinc	Found at both stations at mean concentrations of 18 to 246 ug/l. Environment Canada Codes require a level of 500 ug/l achievable by alkali treatment. Exclude from limits.
9a	Iron	Found at both stations at mean concentrations of 456 to 1130 ug/l. Environment Canada Codes require a level of 1000 ug/l weekly composite average. BAT not identified for this stream. Exclude from limits.
14	Phenolics(4AAP)	Found at Darlington only. Maximum concentration : 31.3 ug/l. No BAT identified Data considered unreliable due to possible auto-sampler contamination. Exclude from limits.
16	Methylene chloride	Found at one oily water separator at Pickering station. Maximum concentration is 26.6 mg/l. Suspected contaminant as this parameter used as solvent in the laboratory. No BAT identified. Exclude from limits
25	Oil & Grease	Found at both stations. LTAs vary from 1.78 to 2.93 mg/l. Maximum concentrations vary from 4.1 to 10.7 mg/l. LSS agreed to limit all discharges at 15 mg/l (current industrial discharge guideline).

Section 6

Electric Power Generation Sector
The Effluent Monitoring and Effluent Limits Regulation

Section 6
The Effluent Monitoring and Effluent Limits Regulation

Contents

Section		Page
6.0	**Introduction**	1
6.1	**The Effluent Limits Regulation**	1
6.2	**General**	1
	6.2.1 Interpretation	1
	6.2.2 Purpose	2
	6.2.3 Application	2
	6.2.4 Compliance: Plant Concentration Limits	2
	6.2.5 By-passes	2
	6.2.6 Sampling and Analytical Procedures	3
6.3	**Sampling Points**	3
6.4	**Calculation of Loading and Concentrations**	4
6.5	**Parameter and Lethality Limits**	4
	6.5.1 Daily Concentration Limits	4
	6.5.2 Monthly Average Concentration Limits	5
	6.5.3 pH	5
	6.5.4 Acute Lethality	5
6.6	**Monitoring**	5
	6.6.1 Process Effluent	5
	6.6.2 Quality Control	6
	6.6.3 Assessment Monitoring - Building Effluent	7
	6.6.4 Acute Lethality Testing	7
	6.6.5 Chronic Toxicity	7
6.7	**Effluent Volume**	8
	6.7.1 Flow Measurement	8
	6.7.2 Calculation of Plant Volumes	8
6.8	**Storm Water Control Study**	8
6.9	**Records and Reports**	9
	6.9.1 Record Keeping	9
	6.9.2 Reports Available to the Public	10
	6.9.3 Reports to the Director	10
6.10	**Compliance**	11
6.11	**Revocation**	11
6.12	**References**	12

6.0 Introduction

The purpose of the Effluent Monitoring and Effluent Limits Regulation is to enhance the quality of effluent that is discharged directly to the water courses by Ontario electric power generation sector (EPGS) stations. This will be achieved by:

- controlling the discharge concentrations of specific pollutants
- requiring all effluent to be non-acutely lethal
- where levels of specified pollutants are at untreatable levels or treatment technology has not been identified, the performance demonstrated during the monitoring Regulation may be prescribed

This section describes the main requirements of the electric power generation sector effluent monitoring and effluent limits Regulation.

6.1 The Effluent Limits Regulation

The Regulation consists of thirty six sections organized under ten parts and four schedules including interpretation, application, sampling points, calculation of concentrations and loadings, parameter and lethality limits, monitoring, effluent volume calculation, storm water control study requirements, records and reports, compliance dates, revocation provisions, list of plants under the Regulation and concentration limits and monitoring frequency schedules.

A specific provision in this regulation is the specified list of contaminants to be monitored under the storm water control study.

6.2 Part I - General

6.2.1 Interpretation

Section 1 of the Regulation provides definitions of terms used in the Regulation in order to clarify the meaning of those terms which may have different interpretations and to explain technical terms which may not be in common usage.

6.2.2 Purpose

The purpose as stated in the section is to monitor and control the quality of discharge of effluents from the EPGS. Only plants listed in Schedule 1 that discharge a process effluent are covered under this regulation.

6.2.3 Application

Section 3 of the Regulation specifies that the Regulation applies to only those sites listed in Schedule 1. There are 14 sites to which this Regulation applies: eight sites under the fossil subcategory, four sites under the nuclear subcategory and two sites under the nuclear associated facilities.

A special feature of this regulation is the requirement to commence pre-compliance monitoring on one representative ash quench water and boiler seal water effluent or a combination of the two effluent, at the plants at Nanticoke, Lakeview and Lambton for only the last of the three years prior to compliance monitoring. These streams were not monitored earlier during the MISA monitoring regulation phase.

This regulation does not apply to boiler blowdown (including boiler-lay-up) or to oily water separators solely treating storm waters.

The regulation does not apply to flue gas desulphurization waste water effluent(s).

6.2.4 Compliance: Plant Concentration Limits

The compliance requirements of the Regulation come into force three (3) years after the Regulation is promulgated. The regulated limits listed in Schedule 2 of the Regulation apply to the respective specified process effluent. If a site fails to comply with the requirements of Schedule 2 by exceeding the limit, the event may be subject to enforcement action as deemed appropriate by the Ministry. The Regulation prescribes the following types of process effluent limits:

1) Daily concentration limits: A site must not exceed the daily process effluent streams concentration limits as specified in Column 4 of Schedule 2 on any operating day.

2) Monthly average concentration limits: A site must not exceed the monthly average process effluent streams concentration limits as specified in Column 5 of Schedule 2 during any month of the year.

3) pH: A site must not discharge any process effluent that has a pH below 6.0 or above 9.5 at any time.

4) Acute Lethality: A site must not discharge any process effluent or building effluent that is acutely lethal to either rainbow trout or Daphnia magna. An acutely lethal effluent is one that kills more than fifty percent of test species in 100 percent (undiluted) effluent.

6.2.5 By-Passes

All effluent must be discharged through designated sampling points only and any by-passes of discharges around sampling point are prohibited after three years from filing this regulation.

6.2.6 Sampling and Analytical Procedures

In order to ensure the accurate sampling and analysis of effluent samples, standard sampling and analytical procedures have been developed by the Ministry. The Ministry Protocol for the Sampling and Analysis of Industrial/Municipal Waste Water[1] outlines how a plant must collect a sample, how the sample should be analyzed and the analytical method detection level that the laboratory must achieve when analyzing a sample.

Each plant must ensure that all sampling equipment is properly maintained and operated in order to collect a representative sample.

6.3 Part II - Sampling Points

A plant must designate all sampling points that allow representative samples to be collected for all process effluent and building effluent. All samples collected under the Regulation must be taken from these designated points.

An alternate sampling point for toxicity samples only is permitted at the Bruce Heavy Water Plant.

6.4 Part III - Calculation of Loadings and Concentrations

All required limits under the Regulation are based on concentrations. To determine compliance with the monthly average concentration limit, a monthly average concentration is calculated by taking the arithmetic mean of the daily concentrations of the samples that are required by the Regulation throughout the month.

Although loadings are not limited under the Regulation, however, they must be calculated and reported for all process effluent and building effluent.

The following rules must be followed by the site when calculating parameter loadings:

- The actual analytical results obtained by the laboratory should be used by the discharger
- If the actual result is less than one-tenth of the analytical method detection limit set out in the Ministry Protocol[2] then the discharger should use the value zero for the purpose of performing calculations.

A daily effluent stream loading, in kilograms, is calculated by multiplying the analytical results obtained from the sample by the measured daily volume of effluent discharged at the sampling point.

A daily process effluent plant loading for a parameter for a day is the sum, in kilograms, for all daily process effluent stream loadings.

A monthly average process effluent plant loading for a parameter for a month is the arithmetic mean of the daily process effluent plant loadings for the parameter.

A quarterly building effluent plant loading for a parameter for a quarter is the sum, in kilograms, for all daily building effluent stream loadings monitored in that quarter.

6.5 Part IV - Parameter and Lethality Limits

6.5.1 Daily Concentration Limits

A plant must not exceed the daily concentration limits listed in Column 3 of Schedule 2 on any operating day.

6.5.2 Monthly Average Concentration Limits

A plant must not exceed the monthly average concentration limits listed in Column 4 of Schedule 2 during any month.

In the Regulation, limits are specified for Aluminum, Iron, Zinc, Total Phosphorus, Ammonia plus Ammonium, Total Suspended Solids, Oil & Grease, BOD (5 day) and sulphide.

6.5.3 pH

The Regulation states that a plant must not discharge a process effluent that has a pH below 6.0 or above 9.5 at any time.

6.5.4 Acute Lethality

A plant must not discharge a process effluent or a building effluent that is acutely lethal to rainbow trout (96 hour test) or Daphnia magna (48 hour test). An acutely lethal effluent is one that kills more than fifty percent of the test species in undiluted
(one hundred percent) effluent.

6.6 Part V - Monitoring

6.6.1 Process Effluent

Each discharger is required to collect a 24-hour composite sample of most process effluent daily and weekly. The daily and weekly samples must be analyzed for the parameters for which the frequency of monitoring is indicated in Column 2 of Schedule 2 as being daily or weekly respectively. The frequency of monitoring for each limited parameter is shown in Table 6.1 below.

The notable exceptions are:

The discharges from Lake Lambton Coal Pile Effluent at Lambton TGS where weekly grab sampling is permitted; and

Fossil subcategory oily water separators may sample weekly.

Table 6.1
Monitoring Frequency for Limited Parameters

ATG	Parameter	Frequency
1a	BOD (5day)	Weekly
3	pH	Daily
4a	Ammonia plus ammonium	Weekly
6	Total Phosphorus	Weekly
8	Total Suspended Solids	Daily/Weekly
9	Aluminum	Weekly
9	Zinc	Weekly
9a	Iron	Daily/Weekly
5	Sulphide	Daily
25	Oil and Grease	Daily/Weekly

For the purpose of monitoring pH, the discharger must collect three grab samples daily, no sooner than four hours apart, and analyze each sample for pH and calculate an average value. Alternatively, a discharger may use an on-line analyzer.

6.6.2 Quality Control

Once each year each discharger shall:

- prepare and analyze a travelling blank and a travelling spiked blank sample for all the limited parameters except pH and Total Suspended Solids for one process effluent (see below)

- collect from one process effluent sampling point at each site a duplicate sample and analyze for all of the limited parameters

The samples for quality control must be collected on the same day as the regular compliance monitoring samples for the limited parameters. Procedures for collecting these quality control samples are outlined in the Ministry of Environment and Energy "Protocol for Sampling and Analysis of Industrial/Municipal Wastewater[1]"

6.6.3 Assessment Monitoring - Building Effluent

Building Effluent are monitored once per each calendar quarter for Total Suspended Solids and Oil & Grease.

6.6.4 Acute Lethality Testing

During the first year that the Regulation is in effect, each discharger is required to conduct monthly acute lethality tests on each process effluent in order to determine whether the plant's process effluent is acutely lethal to rainbow trout or Daphnia magna. The Environment Canada protocols on acute toxicity testing[2,3] describe the sampling and analytical procedures that have to be followed when conducting acute lethality tests.

If a process effluent at a station passes twelve consecutive tests for a process effluent then the discharger is allowed to monitor the acute lethality on a reduced quarterly basis for that process effluent.

The discharger is required to conduct quarterly acute lethality testing for all building effluent.

6.6.5 Chronic Toxicity

When a plant process effluent passes twelve consecutive acute lethality tests and commences quarterly testing, a discharger is required to monitor for chronic toxicity to Ceriodaphnia dubia and fathead minnows, once ever six months. These seven day tests study Ceriodaphnia dubia reproduction inhibition and survivability and fathead minnow growth inhibition in 100% process effluent. If an effluent is subsequently found to be acutely lethal to rainbow trout or Daphnia magna then the discharger may cease chronic toxicity testing and must again begin monitoring acute toxicity at a monthly frequency until a further twelve consecutive non-toxic samples are achieved. The Environment Canada protocols on chronic toxicity testing[4,5] describe the sampling and analytical procedures that have to be followed when conducting the chronic toxicity tests.

6.7 Part VI - Effluent Volume

6.7.1 Flow Measurement

In order to determine daily and monthly plant loadings, each discharger must continuously measure the daily flow of all process effluent streams. Each flow measurement device must:

- be installed properly and be easily accessible for inspection by a provincial officer; and
- be accurate to ± 15%.

Each discharger must also determine building effluent discharge volume on each day there is a discharge. The daily flow volume determination method must be accurate to within ± 20%

6.7.2 Calculation of Plant Volumes

Each discharger will calculate, in cubic metres, a monthly average process effluent plant volume for each month by averaging the sum of the daily process effluent volumes.

Each discharger will calculate a daily and monthly building effluent plant volume by summing up the individual building effluent plant volumes discharged on that day.

6.8 Part VII - Storm Water Control Study

Each discharger must complete a storm water control study within four years after the regulation comes into force according to the Ministry of the Environment and Energy protocol for conducting a storm water control study[6]. The discharger may be exempted from a storm water control study if they qualify for exemption as specified i n the protocol.

Schedule 4 parameters will be the minimum number of parameters to be investigated under this study.

6.9 Part VIII - Records and Reports

6.9.1 Record Keeping

Each discharger shall make each record required under the Regulation as soon as reasonably possible. All records are to be kept for at least three years and should be accessible to the Ministry for inspection. Records are normally required to be in an electronic format. In some cases, hard copies of the electronic records are also required.

Records of the following shall be maintained:

- all analytical results obtained under the monitoring requirements and all calculations performed
- all sampling and analytical procedures used including, for each sample, the date, time of pick-up and any incidents likely to affect the analytical results
- the results of all quality control monitoring, acute lethality and chronic toxicity testing
- all records of flow measurement as well as records of maintenance and calibration of flow measuring/data logging devices
- all problems of malfunction related to sampling, chemical analysis, acute lethality and chronic toxicity testing and flow measuring devices detailing the date and duration of any malfunction and the remedial action taken
- any by-passes stating the date, duration, cause and nature of each by-pass
- all process changes and redirection of or changes in the character of effluent streams that affect the quality of effluent at any sampling point
- the location of each sampling point established at the discharger's plant

6.9.2 Reports Available to the Public

Each discharger is required to prepare by June 1 an annual summary, relating to the previous calendar year, of all test results and calculations (concentrations, loadings, flows and toxicity) and all non-compliance events and make the summary available to the public or the Director upon request during the plant's normal office hours.

6.9.3 Reports to the Director

Each discharger is required to notify the Director in writing of:

- any change in name or ownership occurring after the day the Regulation comes into force, within thirty days after the end of the month in which the change occurs

- any process change or redirection of or change in the character of an effluent stream that affects the quality of the effluent at any sampling point within thirty days of the change or redirection

- any non-compliance event (concentration limit, pH range, lethality, by-pass)

Quarterly Reports to the Director

- Each discharger is required to submit a quarterly report to the Director in an electronic format and in hard copy no later than forty-five days after the end of each quarter. The report should include:

- the monthly average plant loadings, the highest and lowest daily plant loadings and the monthly average concentration and the highest and lowest daily concentration for the month for each limited parameter and the quarterly plant loadings for each Schedule 3 assessment parameter.

- the monthly average process effluent plant volume and the highest and lowest daily process effluent plant volume.

- the monthly building effluent plant volume

- the highest and lowest pH results obtained for each month in the quarter for each process effluent monitoring stream
- the number of days and dates in each month in the quarter on which each process effluent and building effluent was discharged from the discharger's plant

Reports to the Director on Chronic Toxicity Testing

- A discharger is required to report the results of all Chronic Toxicity Testing within sixty days after the semi-annual period for which the samples were collected.

6.10 Part IX - Compliance

Compliance Dates (Assumes Jan 1, 1995 filing)

- Section 6 by January 1, 1998
- subsections 8(1) & 9(1) by April ..., 1995
- subsection 3(3) by January 1, 1997
- Part IV by January 1, 1998
- Part V and VI by April ..., 1995

6.11 Part X - Revocation

Revocation Provisions (Assumes Jan 1, 1995 filing)

- Ontario Regulation 726/89 is revoked on April ..., 1995
- Subsections 22(13), 22(14), 22(19) and 22(20) deeming certain process effluent or building effluent as acutely lethal are revoked on January 1, 1998.

6.12 References

1. Ontario Ministry of the Environment and Energy, Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater, August 1994, PIBS # 2724

2. Environment Canada, Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, EPS 1/RM/13, July 1990

3. Environment Canada, Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia Magna*, EPS 1/RM/14, July 1990

4. Environment Canada, Biological Test Method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia*, EPS 1/RM/21, February 1992

5. Environment Canada, Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows, EPS 1/RM/22, February 1992

6. Ontario Ministry of Environment and Energy, Protocol for Conducting a Storm Water Control Study, August 1994 PIBS # 2695E

Appendix A

Draft Effluent Monitoring and Effluent Limits Regulation
Electric Power Generation Sector

DRAFT EFFLUENT MONITORING AND EFFLUENT LIMITS

REGULATION

ELECTRIC POWER GENERATION SECTOR

This Draft Regulation has not been finally reviewed by the Registrar of Regulations or by counsel of the Registrar of Regulations or by the Minister's Office, and may be subject to wording or other changes.

ONTARIO MINISTRY OF ENVIRONMENT AND ENERGY

TABLE OF CONTENTS

		Page
PART I -	**GENERAL**	1
Section 1	- Interpretation	1
Section 2	- Purpose	5
Section 3	- Application	5
Section 4	- Obligations Under Approvals, Orders, etc.	6
Section 5	- Non-application of General Effluent Monitoring Regulations	6
Section 6	- By-passes	6
Section 7	- Sampling and Analytical Procedures	7
PART II -	**SAMPLING POINTS**	8
Section 8-	Establishment and Elimination of Sampling Points	8
Section 9-	Reports on Sampling Points	10
Section 10-	Use of Sampling Points Established Under this Part	10
PART III -	**CALCULATION OF LOADINGS AND CONCENTRATIONS**	10
Section 11-	Calculation Under this Part - General	10
Section 12-	Calculation of Loadings - Process Effluent	11
Section 13-	Calculation of Loadings - Building Effluent	12
Section 14-	Calculation of Concentrations -Process Effluent	13
PART IV -	**PARAMETER AND LETHALITY LIMITS**	13
Section 15-	Parameter Limits	13
Section 16-	Lethality Limits	13
PART V -	**MONITORING**	14
Section 17-	Monitoring - General	14
Section 18-	Monitoring - Process Effluent - Daily	15
Section 19-	Monitoring - Process Effluent - Weekly	15
Section 20-	Monitoring - Process Effluent -Quality Control	16
Section 21-	Monitoring - Process Effluent - pH Measurement	17
Section 22-	Monitoring - Acute Lethality Testing - Rainbow Trout	18
Section 23-	Monitoring - Acute Lethality Testing - Daphnia magna	20
Section 24-	Monitoring - Chronic Toxicity Testing- Fathead Minnow and Ceriodaphnia Dubia	20
Section 25-	Monitoring - Building Effluent - Quarterly Assessment	21

Table of Contents (Continued)

PART VI	-	**EFFLUENT VOLUME**	22
Section 26-		Flow Measurement	22
Section 27-		Calculation of Plant Volume	23
PART VII	-	**STORM WATER CONTROL STUDY**	24
Section 28-		Storm Water Control Study	24
PART VIII	-	**RECORDS AND REPORTS**	25
Section 29-		Record Keeping	25
Section 30-		Reports Available to the Public	26
Section 31-		Reports to the Director - General	27
Section 32-		Reports to the Director on Compliance with Section 6 and Part IV	28
Section 33-		Quarterly Reports to the Director	28
Section 34-		Reports to the Director on Chronic Toxicity	29
PART IX	-	**COMPLIANCE**	30
Section 35-		Compliance Dates	30
PART X	-	**REVOCATION**	30
Section 36-		Revocation Provisions	30
		SCHEDULES	
Schedule 1-		List of Regulated Plants	31
Schedule 2-		Process Effluent Limits & Monitoring Frequency	32
Schedule 3-		Building Effluent Assessment Monitoring	41
Schedule 4-		Storm Water Control Study	42

CLEAN WATER REGULATION MADE UNDER
THE ENVIRONMENTAL PROTECTION ACT

EFFLUENT MONITORING AND EFFLUENT LIMITS - ELECTRIC POWER GENERATION SECTOR

PART I-GENERAL

Interpretation

1.-(1) In this Regulation,

"ash quench water effluent" means water that is discharged continuously from a water-impounded bottom ash hopper system to maintain a constant level of water in the ash hopper;

"ash transport water effluent" means water used to transport boiler bottom ash out of the boiler hopper and may include ash quench water, pyrites removal water, coal pile effluent, water treatment plant effluent, boiler seal water and equipment cleaning effluent;

"ash transport water effluent monitoring stream" means an ash transport water stream on which a sampling point is established under section 8;

"ash transport water effluent sampling point" means a sampling point established on an ash transport water effluent stream under section 8;

"assessment parameter" means a parameter that is listed in Schedule 3;

"boiler blowdown water" means water that is discharged from a boiler for the purpose of controlling the level of water in the boiler or for the purpose of discharging contaminants from the boiler;

"boiler seal water effluent" means water that is used to provide a seal between a boiler and a water-impounded bottom ash hopper;

"building effluent" means effluent that is collected from equipment drains, floor drains or trenches within a building or

any combinination of the above with cooling water;

"building effluent monitoring stream" means a building effluent stream on which a sampling point is established under section 8;

"building effluent sampling point" means a sampling point established on a building effluent stream under section 8;

"coal pile effluent" means effluent collected from an outdoor coal pile storage area;

"coal pile effluent monitoring stream" means a coal pile effluent stream on which a sampling point is established under section 8;

"coal pile effluent sampling point" means a sampling point established on a coal pile effluent stream under section 8;

"cooling water effluent" means water and associated material that is used in an industrial process for the purpose of removing heat and that has not, by design, come into contact with process material;

"discharger" means an owner or person in occupation or having the charge, management or control of a plant to which this Regulation applies;

"Director", in relation to obligations of a discharger, means a Director appointed under section 5 of the Act and responsible for the region in which the discharger's plant is located and includes an alternate named by the Director;

"equipment cleaning effluent" means effluent that results from the washing or chemical cleaning of industrial equipment, including boilers, heat exchangers and cleaning or maintenance operations during periods when all or part of the plant is shut down;

"equipment cleaning effluent monitoring stream" means an equipment cleaning effluent stream on which a sampling point is established under section 8;

"equipment cleaning effluent sampling point" means a sampling point established on an equipment cleaning effluent stream under section 8;

"flue gas desulphurization effluent" means all effluent that results from the operation of a flue gas desulphurization system;

"limited parameter", in relation to a plant, means a parameter for which a limit is specified for the plant in column 3 or 4 of Schedule 2;

"oily water separator effluent" means effluent that results from any equipment designed for the physical separation of oil from water;

"oily water separator effluent monitoring stream" means an oily water separator effluent stream on which a sampling point is established under section 8;

"oily water separator sampling point" means a sampling point established on an oily water separator effluent stream under section 8;

"pick-up", in relation to a sample, means pick-up for the purpose of storage, if any, at a plant, including storage within an automated sampling device at the plant, and transportation to and analysis at a laboratory;

"plant" means an industrial facility and the developed property, waste disposal sites and wastewater treatment facilities associated with it;

"process change" means a change in equipment, production processes, process materials or treatment processes;

"process effluent" means,

(a) effluent, that, by design, has come into contact with process materials;

(b) ash transport water effluent;

(c) ash quench water effluent at the Lakeview TGS, Lambton TGS and Nanticoke TGS plants;

(d) boiler seal water effluent at the Lakeview TGS, Lambton TGS and Nanticoke TGS plants;

(e) water treatment plant effluent;

(f) coal pile effluent;

(g) Bruce Heavy Water Plant process effluent;

(h) Bruce Heavy Water Plant process effluent lagoon effluent;

(i) oily water separator effluent;

(j) radioactive liquid waste management system tank effluent

(k) Industrial sewage treatment plant effluent at the Darlington NGS and the Bruce Nuclear Power Development plants;

"process effluent monitoring stream" means a process effluent stream on which a sampling point is established under section 8;

"process effluent sampling point" means a sampling point established on a process effluent stream under section 8;

"process materials", in relation to a discharger's plant, means raw materials for use in an industrial process at the plant, manufacturing intermediates produced at the plant, or products or by-products of an industrial process at the plant, but does not include chemicals added to cooling water for the purpose of controlling organisms, fouling and corrosion;

"quarter" means all or part of a period of three consecutive months beginning on the first day of January, April, July or October;

"radioactive liquid waste management system tank effluent" means effluent from plant drainage which may contain radioactive materials that is collected in tanks and periodically discharged;

"radioactive liquid waste management system tank effluent monitoring stream" means a radioactive liquid waste management system tanks stream on which a sampling point is established under section 8;

"radioactive liquid waste management system tank effluent sampling point" means a sampling point established on a radioactive liquid waste management system tanks effluent stream under section 8;

"Schedule 3 assessment parameter" means a parameter that is listed in Schedule 3;

"Schedule 4 storm water assessment parameter" means a parameter listed in Schedule 4;

"semi-annual period" means all or part of a period of six months beginning on the first day of January or July;

"storm water effluent" means run-off, other than coal pile effluent, from a storm event or thaw that is not used in any industrial process;

"storm water assessment parameter" means a parameter listed in Schedule 4;

"water treatment plant effluent" means effluent generated from water treatment plant operations;

"water treatment plant effluent monitoring stream" means a water treatment plant effluent stream on which a sampling point is established under section 8;

"water treatment plant effluent sampling point" means a sampling point established on a water treatment plant effluent stream under section 8;

(2) For greater certainty, this Regulation applies both to effluent streams that discharge continuously and to effluent streams that discharge intermittently.

(3) An obligation on a discharger to do a thing under this Regulation is discharged if another person has done it on the discharger's behalf.

Purpose

2. The purpose of this Regulation is to monitor and control the quality of effluent discharged from the plants listed in Schedule 1 that discharge a process effluent.

Application

3.-(1) This Regulation, subject to section 2, applies only with respect to the plants listed in Schedule 1.

(2) This Regulation does not apply with respect to the discharge of effluent to a municipal sewer.

(3) This Regulation does not apply with respect to ash quench water effluent and boiler seal water effluent at Nanticoke TGS, Lambton TGS and Lakeview TGS plants for the first twenty-four months from *.....xx, 199_, after which period, the monitoring requirements prescribed in Schedule 2 would apply to any one ash quench water effluent, boiler seal water effluent, or combination of ash quench and boiler seal water effluent streams discharged from any one boiler at any plant for the period from **.....,xx, 199_ to ***.....xx, 199_.

(*Insert regulation filing date; **Insert first day of 25 th.month from regulation filing date; *** Insert first day of 37 th. month from regulation filing date)

(5) This Regulation does not apply to boiler blowdown effluent or to oily water separator effluent that originate from oily water separators treating only storm water.

(6) This regulation does not apply to any flue gas desulphurization effluent.

Obligations Under Approvals, Orders, etc.

4. For greater certainty, the requirements of this Regulation are in addition to and independent of requirements in an approval, order, direction or other instrument issued under any Act.

Non-application of General Effluent Monitoring Regulation

5. This Regulation is not a Sectoral Effluent Monitoring Regulation within the meaning of Ontario Regulation 695/88.

By-passes

6. Commencing on *..... xx, 199_, a discharger shall not permit process effluent to be discharged from the discharger's plant unless the process effluent flows past a sampling point established on a process effluent stream in accordance with this Regulation before being discharged.
(*: Day 1 of 37 th. month after filing regulation to be inserted)

Sampling and Analytical Procedures

7.-(1) Each discharger shall carry out the establishment of sampling point obligations of this Regulation and the sampling and analysis obligations of this Regulation, including quality control sampling and analysis obligations, in accordance with the procedures described in the Ministry of Environment and Energy publication entitled "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater", dated August, 1994.

(2) Each discharger shall maintain the sampling equipment used at the discharger's plant for sampling required by this Regulation in a way that ensures that the samples collected at the plant under this Regulation accurately reflect the level of discharge of each limited parameter and assessment parameter from the plant.

(3) The discharger may pick-up a grab sample from the coal pile effluent monitoring stream at Lambton TGS.

PART II - SAMPLING POINTS

Establishment and Elimination of Sampling Points

8.-(1) Each discharger shall, by *.....xx, 199_, establish a sampling point on each process effluent and building effluent stream at the discharger's plant, as necessary so that the plant loadings calculated under sections 12 and 13 for each limited parameter and assessment parameter and the concentrations determined under sections 14 and 25 for each limited parameter and assessment parameter accurately reflect the level of discharge of each such parameter from the plant.

(*The effective date that is 90 days after the day on which this Regulation is filed will be inserted in subsection 35(b) and above.)

(2) Despite subsection (1), a discharger need not establish a sampling point on a by-pass.

(3) If circumstances change so that a new sampling point is necessary at a discharger's plant in order to permit the calculation of plant loadings under sections 12 and 13 for each limited parameter and assessment parameter and the determination of concentrations under sections 14 and 25 for each limited parameter and assessment parameter that accurately reflect the level of discharge of each such parameter from the plant, the discharger shall, within thirty days of the change, establish the new sampling point.

(4) A discharger may eliminate a sampling point established under subsection (1) or (3) if the sampling point is no longer necessary to permit the calculation of plant loadings under sections 12 and 13 for each limited parameter and assessment parameter and the determination of concentrations under sections 14 and 25 for each limited parameter and assessment parameter that accurately reflect the level of discharge of each such parameter from the plant.

(5) A plant loading for a parameter or a concentration for a parameter that is based on analytical results that are significantly affected by dilution or masking due to the merging of streams upstream of a sampling point at a plant is not a loading or a concentration that accurately reflects the level of discharge of the parameter from the plant.

(6) In determining what is necessary to meet a discharger's obligations to establish sampling points under this section, the discharger shall consider both which streams should have sampling points and where on a stream a sampling point should be located.

(7) For the Bruce Heavy Water Plant, the discharger may establish an alternate sampling point down stream of the point at which process effluent mixes with cooling water but before the point of discharge to Lake Huron only for the purpose of meeting obligations under section 22(22).

Reports on Sampling Points

9.-(1) By* .....xx, 199 , each discharger shall submit to the Director a list and plot plan showing the sampling points established under this Regulation at the discharger's plant as of ** ....xx, 199 .
(* same date as in 8(1) plus 10 days; ** same date as in 8(1))

(2) Within thirty days after establishing a sampling point under this Regulation that is not shown on a list and plot plan submitted under this section, the discharger shall give the Director a written notice describing the location of the sampling point, together with a revised list and plot plan showing the sampling point.

(3) Within thirty days after eliminating a sampling point under this Regulation that is shown on a list and plot plan submitted under this section, the discharger shall give the Director a written notice describing where the sampling point used to be, together with a revised list and plot plan without the sampling point.

Use of Sampling Points Established Under This Part

10. Each discharger shall use the sampling points established under this Part for all sampling required by this Regulation, except as permitted under subsection 22(22).

PART III - CALCULATION OF LOADINGS AND CONCENTRATIONS

Calculation Under this Part - General

11.-(1) For the purposes of performing a calculation under sections 12 to 14, a discharger shall use the actual analytical result obtained by the laboratory.

(2) Despite subsection (1), where the actual analytical result is less than one-tenth of the analytical method detection limit set out in the Ministry of Environment and Energy publication entitled "Protocol for the Sampling and Analysis of Industrial/Municipal

Wastewater" dated August, 1994, the discharger shall use the value zero for the purpose of performing a calculation under sections 12 to 14.

(3) Each discharger shall ensure that each calculation of a process effluent loading required by section 12 and each calculation of a process effluent concentration required by section 14 is performed as soon as reasonably possible after the analytical result on which the calculation is based becomes available to the discharger.

(4) Each discharger shall ensure that each calculation of a building effluent loading required by section 13 is performed in time to comply with subsection 33(4).

Calculation of Loadings - Process Effluent

12.-(1) Each discharger shall calculate, in kilograms, a daily process effluent stream loading for each limited parameter in each process effluent monitoring stream of the discharger for each day on which a sample is collected under this Regulation from the stream for analysis for the parameter.

(2) When calculating a daily stream loading under subsection (1), the discharger shall multiply, with the necessary adjustment of units to yield a result in kilograms, the analytical result obtained from the sample for the parameter by the daily volume of effluent, as determined under section 26, for the stream for the day.

(3) Each discharger shall calculate, in kilograms, a daily process effluent plant loading for each limited parameter for each day for which the discharger is required to calculate a daily process effluent stream loading for the parameter under subsection (1)

(4) For the purposes of subsection (3), a daily process effluent plant loading for a parameter for a day is the sum, in kilograms, of the daily process effluent stream loadings for the parameter calculated under subsection (1) for the day.

(5) Where a discharger calculates only one daily process effluent stream loading for a parameter for a day under subsection (1), the daily process effluent plant loading for the parameter for the day

for the purposes of subsection (3) is the single daily process effluent stream loading for the parameter for the day.

(6) Each discharger shall calculate, in kilograms, a monthly average process effluent plant loading for each limited parameter for each month in which a sample is collected under this Regulation more than once from a process effluent monitoring stream at the discharger's plant for analysis for the parameter.

(7) For the purposes of subsection (6), a monthly average process effluent plant loading for a parameter for a month is the arithmetic mean of the daily process effluent plant loadings for the parameter calculated under subsection (3) for the month.

Calculation of Loadings - Building Effluent

13.-(1) Each discharger shall calculate, in kilograms, a daily building effluent stream loading for each Schedule 3 assessment parameter in each building effluent monitoring stream of the discharger for each day on which a sample is collected under this Regulation from the stream for analysis for the parameter.

(2) When calculating a daily stream loading under subsection (1), the discharger shall multiply, with the necessary adjustment of units to yield a result in kilograms, the analytical result obtained from the sample for the parameter by the daily volume of effluent, as determined under section 26, for the stream for the day.

(3) Each discharger shall calculate, in kilograms, a quarterly building effluent plant loading for each Schedule 3 assessment parameter for each quarter in which a sample is collected under this Regulation from a building effluent monitoring stream at the discharger's plant for analysis for the parameter.

(4) For the purpose of subsection (3), a quarterly building effluent plant loading is the sum of the daily building effluent stream loadings for the parameter calculated under subsection (1) for that quarter.

Calculation of Concentrations - Process Effluent

14.-(1) Each discharger shall calculate, in milligrams per litre, a monthly average concentration for each limited parameter in each process effluent monitoring stream of the discharger for each month.

(2) For the purposes of subsection (1), a monthly average concentration for a parameter for a month is the arithmetic mean of the analytical results obtained for the parameter from the samples collected under sections 18 and 19 throughout the month.

(3) Where only one sample is collected under sections 18 and 19 throughout the month, the monthly average concentration for the parameter for the month is the concentration for the sample collected.

PART IV - PARAMETER AND LETHALITY LIMITS

Parameter Limits

15.-(1) Each discharger shall ensure that each analytical result obtained for each limited parameter from each sample collected from a process effluent monitoring stream at the discharger's plant does not exceed the daily concentration limit specified for the parameter and the plant in column 3 of Schedule 2.

(2) Each discharger shall ensure that each monthly average concentration calculated for a limited parameter under section 14 in connection with the discharger's plant does not exceed the monthly average concentration limit specified for the parameter and the plant in Column 4 of Schedule 2.

(3) Each discharger shall control the quality of each process effluent monitoring stream at the discharger's plant to ensure that the pH value of any sample collected at a process effluent sampling point at the plant is within the range of 6.0 to 9.5.

Lethality Limits

16. Each discharger shall control the quality of each process effluent monitoring stream and each building effluent monitoring

stream at the discharger's plant to ensure that each rainbow trout acute lethality test and each Daphnia magna acute lethality test performed on any grab sample collected at a process effluent sampling point or a building effluent sampling point at the plant results in mortality for no more than fifty percent of the test organisms in one-hundred percent effluent.

PART V - MONITORING

Monitoring - General

17.-(1) Despite sections 18 to 25 a discharger need not collect samples from any stream at the discharger's plant on a day on which a process effluent or a building effluent is not discharged from the plant.

(2) Where a discharger is required by this Regulation to pick-up a set of samples and analyze it for certain parameters, the discharger shall pick-up a set of samples sufficient to allow all the analyses to be performed.

(3) A discharger shall use all reasonable efforts to ensure that all analyses required by this Regulation are completed as soon as reasonably possible and that the results of those analyses are made available to the discharger as soon as reasonably possible.

(4) Subject to subsection (5), each discharger shall pick-up all sets of samples required to be picked-up at the discharger's plant under sections 18, 19 and 25 between the hours of 9.00 a.m. and 12.00 noon.

(5) If the Director is satisfied, on the basis of written submissions from a discharger, that the circumstances at the discharger's plant are such that it would be impractical to pick-up a set of samples from each process effluent and building effluent sampling point established at the plant under this Regulation within the time period specified in subsection (4), the Director may give the discharger a written notice in respect of the plant, varying the time period specified in subsection (4).

(6) Subject to subsections (7) and (8), where a discharger is required by sections 18, 19 and 25 to pick-up a set of samples, the discharger shall pick-up a set collected over the twenty-four hour period immediately preceding the pick-up.

(7) The twenty-four hour period referred to in subsection (6) may be shortened or enlarged by up to three hours to permit a discharger to take advantage of the three hour range specified in subsection (4) or of a different three hour period specified in a notice under subsection (5).

(8) Where a notice has been given under subsection (5) in respect of a plant specifying a time period longer than three hours, the twenty-four hour period referred to in subsection (6) may be shortened or enlarged by up to that longer amount of time to permit the discharger to take advantage of the time period specified in the notice.

(9) If the circumstances at a plant change so that the Director is satisfied that the circumstances described in subsection (5) no longer apply at the plant, the Director may revoke a notice given in respect of a plant under subsection (5) by giving a notice of revocation in writing to a discharger for the plant.

Monitoring - Process Effluent - Daily

18.-(1) Each discharger shall, on each day, pick-up a set of samples collected at each process effluent sampling point at the discharger's plant and shall analyze each set of samples for the parameters for which the frequency of monitoring, as set out in column 2 of Schedule 2 for the discharger's plant, is daily.

(2) A discharger need not meet the requirements of subsection (1) where it is impossible to do so because of sampling by a provincial officer.

Monitoring - Process Effluent - Weekly

19.-(1) Each discharger shall, on one day in each week on a day on which the samples were picked up at the plant under subsection 18(1) in the week, pick-up a set of samples collected at each process effluent sampling point at the discharger's plant and shall analyze each set of samples for the parameters for which the frequency of monitoring, as set out in column 2 of Schedule 2 for the discharger's plant, is weekly.

(2) There shall be an interval of at least four days between successive pick-up days at the plant under subsection (1).

(3) All samples picked-up under subsection (1) in a week shall be picked-up on the same day in the week.

Monitoring - Process Effluent -Quality Control

20.-(1) On one day in each year after 1994, on a day on which samples are picked-up at the plant under subsection 18(1), each discharger shall collect and pick-up a duplicate sample for each sample picked-up on that day under subsection 18(1) at one process effluent sampling point at the discharger's plant and shall analyze each duplicate sample for the parameters for which the frequency of monitoring, as set out in column 2 of Schedule 2, is daily.

(2) On one day in each year after 1994, on a day on which samples are picked-up at the plant under subsection 19(1), each discharger shall collect and pick-up a duplicate sample for each sample picked-up on that day under subsection 19(1) at one process effluent sampling point at the discharger's plant and shall analyze each duplicate sample for the parameters for which the frequency of monitoring, as set out in column 2 of Schedule 2, is weekly.

(3) Each discharger shall ensure that the same process effluent sampling point is used at the dischargers's plant for the purposes of sampling under subsections (1) and (2) in a year.

(4) Each discharger shall prepare a travelling blank and travelling spiked blank sample for each sample for which a duplicate sample is picked-up at the plant under subsection (1) or (2) and shall analyze the travelling blank and travelling spiked blank samples in accordance with the directions set out in the Ministry of Environment and Energy publication entitled "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater", dated August, 1994.

(5) There shall be an interval of at least six months between successive pick-up days at the plant under subsection (1).

(6) There shall be an interval of at least six months between successive pick-up days at the plant under subsection (2).

Monitoring - Process Effluent - pH Measurement

21.-(1) During each twenty-four hour period commencing at 9:00 a.m., each discharger shall, on each day, collect three grab samples from each process effluent sampling point at the discharger's plant and shall analyze each sample for the parameter pH.

(2) There shall be an interval of at least four hours between each of the three collections at a sampling point under subsections (1) in each twenty-four hour period.

(3) Each grab sample collected under subsections (1) shall be picked-up within four hours of when it was collected.

(4) Instead of complying with subsections (1) with respect to a sampling point, during each twenty-four hour period commencing at 9:00 a.m. on each day, a discharger may use an on-line analyzer at the sampling point on the stream and analyze the effluent at the sampling point for the parameter pH three times in each day.

(5) There shall be an interval of at least four hours between each of the three analyses at a sampling point under subsection (4) in each twenty-four hour period.

Monitoring - Acute Lethality Testing - Rainbow Trout

22.-(1) Where a discharger is required by this section to perform a rainbow trout acute lethality test, the discharger shall perform the test according to the procedures described in the Environment Canada publication entitled "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout", dated July, 1990.

(2) Each rainbow trout acute lethality test required by this section shall be carried out as a single concentration test using one hundred percent effluent.

(3) On one day in each month, on a day on which samples are picked-up at the plant under subsection 19(1), each discharger shall collect and immediately pick-up a grab sample at each process effluent sampling point at the discharger's plant and shall perform a rainbow trout acute lethality test on each sample.

(4) There shall be an interval of at least fifteen days between successive pick-up days at the plant under subsection (3).

(5) All samples picked-up under subsection (3) in a month shall be picked-up on the same day in the month.

(6) Where a discharger has performed tests under subsection (3) for twelve consecutive months on samples collected from the same sampling point and the mortality of the rainbow trout in each test did not exceed fifty percent, the discharger is relieved of the obligations under subsection (3) relating to the sampling point and shall instead collect and immediately pick-up a grab sample at the sampling point on one day in each quarter and perform a rainbow trout acute lethality test on each sample.

(7) Samples picked-up at a plant under subsection (6) shall be picked-up on a day on which samples are picked-up at the plant under subsection (3).

(8) If no samples are being picked-up at a plant under subsection (3) during a quarter, samples picked-up at the plant during the quarter under subsection (6) shall be picked-up on a day on which samples are picked-up at the plant under subsection 19(1).

(9) There shall be an interval of at least forty-five days between successive pick-up days at the plant under subsection (6).

(10) All samples picked-up under subsection (6) in a quarter shall be picked-up on the same day in the quarter.

(11) If a rainbow trout acute lethality test performed under subsection (6) on any sample from a sampling point results in mortality of more than fifty percent of the test rainbow trout, subsections (6) to (10) cease to apply in respect to samples from that sampling point, and a discharger shall instead comply with the requirements of subsection (3) relating to the sampling point, until the tests performed under subsection (3) on all samples collected from the sampling point for a further twelve consecutive months result in mortality for no more than fifty percent of the rainbow trout for each test.

(12) A discharger shall notify the Director in writing of any change in the frequency of acute lethality testing under this Regulation at the discharger's plant, within thirty days after the day on which the change begins.

(13) A discharger may notify the Director in writing of any period in which the testing of samples collected at a sampling point under subsection (3) would always result in mortality of more than fifty percent of the test rainbow trout.

(14) Where a notice is given under subsection (13), a discharger is relieved of the obligations under subsection (3) relating to the sampling point during the period in which the testing of samples collected at the sampling point would always result in mortality of more than fifty percent of the test rainbow trout.

(15) Subsections (13) and (14) are revoked on ...., 199.. **(The date on which Part IV of this Regulation comes into force will be inserted in subsection 22(15) and 36 (2).)**

(16) On one day in each quarter, on a day on which samples are picked-up at the plant under subsection 25(1), each discharger shall collect and immediately pick-up a grab sample at each building effluent sampling point at the discharger's plant and shall perform a rainbow trout acute lethality test on each sample.

(17) There shall be an interval of at least forty-five days between successive pick-up days at the plant under subsection (16).

(18) All samples picked-up under subsection (16) in a quarter may be picked-up on any day in the quarter.

(19) A discharger may notify the Director in writing of any period in which the testing of samples collected at a sampling point under subsection (16) would always result in mortality of more than fifty percent of the test rainbow trout.

(20) Where a notice is given under subsection (19), a discharger is relieved of the obligations under subsection (16) relating to the sampling point during the period in which the testing of samples collected at the sampling point would always result in mortality of more than fifty percent of the test rainbow trout.

(21) Subsections (19) and (20) are revoked on ...., 199.. **(The date on which Part IV of this Regulation comes into force will be inserted in subsection 22(21) and 36(2).)**

(22) For the purposes of this section the Bruce Heavy Water Plant may use instead an alternate sampling point established under subsection 8(7).

Monitoring - Acute Lethality Testing - Daphnia magna

23.-(1) Where a discharger is required by this section to perform a Daphnia magna acute lethality test, the discharger shall perform the test according to the procedures described in the Environment Canada publication entitled "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia magna", dated July, 1990.

(2) Subsections 22(2) to 22(22) apply with necessary modifications to Daphnia magna acute lethality tests and, for the purpose, a reference to rainbow trout shall be deemed to be a reference to Daphnia magna.

(3) Each discharger shall pick-up each set of samples required to be collected from a sampling point at the discharger's plant under this section on a day on which the discharger collects a sample from the sampling point under section 22, to the extent possible having regard to the frequency of monitoring required at the sampling point under this section and section 22.

Monitoring - Chronic Toxicity Testing - Fathead Minnow and Ceriodaphnia Dubia

24.-(1) Where a discharger is required to perform a 7-day fathead minnow growth inhibition test, the discharger shall

perform the test according to the procedure described in the Environment Canada publication entitled "Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows" dated February, 1992.

(2) Where a discharger is required to perform a 7-day Ceriodaphnia dubia reproduction inhibition and survivability test, the discharger shall perform the test according to the procedure described in the Environment Canada publication entitled "Biological Test Method: Test of Reproduction and Survival Using The Cladoceran Ceriodaphnia dubia", dated February, 1992.

(3) On one day in each semi-annual period, on a day on which samples are picked-up at the plant under subsection 19(1), each discharger shall collect and immediately pick-up a grab sample from each process effluent sampling point at the discharger's plant, and shall perform a 7-day fathead minnow growth inhibition test and a 7-day Ceriodaphnia dubia reproduction inhibition and survivability test on each sample.

(4) There shall be an interval of at least ninety days between successive pick-up days at the plant under subsection (3).

(5) All samples picked-up under subsection (3) in a semi-annual period shall be picked-up on the same day in the semi-annual period.

(6) A discharger need not collect a sample from a sampling point in accordance with subsection (3) until twelve consecutive monthly rainbow trout acute lethality tests and twelve consecutive monthly Daphnia magna acute lethality tests performed on samples collected at the sampling point at a discharger's plant result in mortality for no more than fifty percent of the test organisms in one hundred percent effluent.

Monitoring - Building effluent - Quarterly Assessment

25.-(1) Each discharger shall, in each quarter, pick-up a grab sample at each building effluent sampling point at the discharger's plant and shall analyze each sample for Schedule 3 assessment parameters.

(2) There shall be an interval of at least forty-five days between successive pick-up days for each sampling point at the plant under subsection (1).

(3) All samples picked-up under subsection (1) in a quarter may be picked-up on any day in the quarter.

PART VI - EFFLUENT VOLUME
Flow Measurement

26.-(1) Subject to section 8, for the purposes of this section, a volume of effluent for a stream for a day is the volume that flowed past the sampling point, established under Part II on the stream, during the twenty-four hour period preceding the pick-up of the first sample picked up from the stream for the day.

(2) Each discharger shall determine in cubic metres a daily volume of effluent for each process effluent stream at the discharger's plant for each day on which a sample is collected under this Regulation from the stream by integration of continuous flow rate measurements.

(3) Despite subsection (2), where a process effluent stream discharges on an intermittent basis, the daily volumes for the stream may be determined either by integration of continuous flow rate measurements or by the summation of individual batch volume measurements.

(4) Each discharger shall use flow measurement methods that allow the daily volumes for process effluent streams to be determined to an accuracy of within plus or minus fifteen percent.

(5) Each discharger shall determine in cubic metres a daily volume of effluent for each building effluent stream at the discharger's plant for each day.

(6) Each discharger shall use flow measurement methods that allow the daily volumes for building effluent stream to be determined to an accuracy of within plus or minus twenty percent.

(7) Each discharger shall determine in cubic metres a volume of effluent for each intermittent equipment cleaning effluent monitoring stream, Nuclear and Nuclear Associated Subcategory oily water separator effluent monitoring stream and Bruce Heavy Water Plant process effluent lagoon effluent monitoring stream at the discharger's plant for each day.

(8) For the purposes of subsection (7), a volume of effluent for an equipment cleaning effluent monitoring stream, Nuclear Subcategory oily water separator effluent monitoring stream and Bruce Heavy Water Plant process effluent lagoon effluent monitoring stream is the volume that flowed past the sampling points on these streams during the day.

(9) Each discharger shall, no later than the day that this section comes into force, determine by calibration or confirm by means of a certified report of a registered professional engineer of the Province of Ontario that each flow measurement method used under subsections (2) and (3) meets the accuracy requirements of subsection (4) and that each flow measurement method used under subsection (5) meets the accuracy requirements of subsection (6).

(10) Where a discharger uses a new flow measurement method or alters an existing flow measurement method, the discharger shall determine by calibration or confirm by means of a certified report of a registered professional engineer of the Province of Ontario that each new or altered flow measurement method meets the accuracy requirements of subsections (4) or (6), as the case may be, within two weeks after the day on which the new or altered method or system is used.

(11) Each discharger shall develop and implement a maintenance schedule and a calibration schedule for each flow measurement system installed at the discharger's plant and shall maintain each flow measurement system according to good operating practices.

(12) Each discharger shall use reasonable efforts to set up each flow measurement system used for the purposes of this section in a way that permits inspection by a provincial officer.

Calculation of Plant Volumes

27.-(1) Each discharger shall calculate, in cubic metres, a daily process effluent plant volume for each day.

(2) For the purposes of subsection (1), a process effluent plant volume for a day is the sum of the daily process effluent volumes determined under section 26 for the day.

(3) Each discharger shall calculate, in cubic metres, a monthly average process effluent plant volume for each month, by taking the arithmetic mean of the daily process effluent plant volumes calculated under subsection (1) for the month.

(4) Each discharger shall calculate, in cubic metres, a daily building effluent plant volume for each day.

(5) For the purposes of subsection (4), a building effluent plant volume for a day is the sum of the daily building effluent volumes determined under section 26 for the day.

(6) Each discharger shall calculate, in cubic metres, a monthly building effluent plant volume for each month.

(7) For the purposes of subsection (6), a building effluent plant volume for a month is the sum of the daily building effluent plant volumes determined under subsection (4) for the month.

PART VII - STORM WATER CONTROL STUDY

Storm Water Control Study

28.-(1) Each discharger shall complete a storm water control study in respect of the discharger's plant, in accordance with the requirements of the Ministry of Environment and Energy publication entitled "Protocol for Conducting a Storm Water Control Study", dated August, 1994.

(2) A discharger need not comply with subsection (1) in respect of the discharger's plant if,

(a) the plant meets the exemption criteria set out in the Ministry of Environment and Energy publication entitled "Protocol for Conducting a Storm Water Control Study", dated August, 1994, and

(b) the discharger notifies the Director in writing, by ...., 199., that the plant meets the exemption criteria referred to in clause (a).

(The date that is one year after the day on which this Regulation is filed will be inserted in clause 28(2)(b).)

(3) Subject to subsection (4), a discharger shall complete the storm water control study in respect of the discharger's plant by ...., 199..

(The date that is two years after the day on which this Regulation is filed will be inserted in subsection 28(3).)

(4) A discharger may postpone completion of the storm water control study in respect of the discharger's plant until ..... **1, 199? if, (first day of 48th. month after filing of Regulation)**

(a) in order to meet the requirements of Part IV, the discharger plans to make process changes, install waste water treatment facilities, implement management practices, or make any other changes at the plant that would likely alter the quantity or quality of stormwater discharged from the plant; and

(b) the discharger notifies the Director in writing, by ...., 199., of the plans referred to in clause (a).

(The date that is two years after the day on which this Regulation is filed will be inserted in subsection 28(4)(b).)

(5) Each discharger shall ensure that a copy of each study completed under this section is available to Ministry staff at the discharger's plant, on request, during the plant's normal office hours.

(6) Despite subsection (1), each discharger shall analyze the storm water samples collected for the parameters listed in Schedule 4.

PART VIII - RECORDS AND REPORTS

Record Keeping

29.-(1) Each discharger shall keep records, in an electronic format acceptable to the Director, of all analytical results obtained under sections 18, 19, 21 and 25, all calculations performed under sections 12, 13, and 14, and all determinations and calculations made or performed under sections 26 and 27.

(2) Each discharger shall keep records of all sampling and analytical procedures used in meeting the requirements of section 7, including, for each sample, the date, the time of pick-up, the sampling procedures used, and any incidents likely to affect the analytical results.

(3) Each discharger shall keep records of the results of all monitoring performed under sections 20 and 22 to 24.

(4) Each discharger shall keep records of all maintenance and calibration procedures performed under section 26.

(5) Each discharger shall keep records of all problems or malfunctions, including those related to sampling, analysis, acute lethality testing, chronic toxicity testing or flow measurement, that result or are likely to result in a failure to comply with a requirement of this Regulation, stating the date, duration and cause of each malfunction, and including a description of any remedial action taken.

(6) Each discharger shall keep records of any incident in which process effluent is discharged from the discharger's plant without flowing past a sampling point established on a process effluent stream in accordance with this Regulation before being discharged, stating the date, duration, cause and nature of each incident.

(7) Each discharger shall keep records of all process changes and redirection of or changes in the character of effluent streams that affect the quality of effluent at any sampling point established under this Regulation at the discharger's plant.

(8) Each discharger shall keep records of the location of each sampling point established at the discharger's plant under Part II.

(9) Each discharger shall make each record required by this section as soon as reasonably possible and shall keep each such record for a period of three years.

(10) Each discharger shall ensure that all records kept under this section are available to Ministry staff at the discharger's plant, on request, during the plant's normal office hours.

Reports Available to the Public

30.-(1) On or before June 1 in each year, each discharger shall prepare a report relating to the previous calendar year and including,

(a) a summary of plant loadings calculated under sections 12 and 13

(b) a summary of concentrations determined under section 14.

(c) a summary of the results of monitoring performed under sections 18, 19 and 21 to 25;

(d) a summary of calculations performed under subsections 27(1), 27(4) and 27(6);

(e) a summary of the concentrations or other results that exceeded a limit prescribed by section 15 or 16; and

(f) a summary of the incidents in which process effluent was discharged from the discharger's plant without flowing past a sampling point established on a process effluent stream in accordance with this Regulation before being discharged.

(2) Each discharger shall ensure that each report prepared under subsection (1) is available to any person, at the discharger's plant, on request, during the plant's normal office hours.

(3) Each discharger shall provide the Director, upon request, with a copy of any report that the discharger has prepared under subsection (1)

Reports to the Director - General

31.-(1) Each discharger shall notify the Director in writing of any change of name or ownership of the discharger's plant occurring after ...., 199., within thirty days after the end of the month in which the change occurs.

(The date that is the day on which this Regulation is filed will be inserted in subsection 31(1))

(2) Each discharger shall notify the Director in writing of any process change or redirection of or change in the character of an effluent stream that affects the quality of effluent at any sampling point established under this Regulation at the discharger's plant, within thirty days of the change or redirection.

(3) A discharger need not comply with subsection (2) where the effect of the change or redirection on effluent quality is of less than one week's duration.

Reports to the Director on Compliance with Section 6 and Part IV

32.-(1) Each discharger shall report any incident in which process effluent is discharged from the discharger's plant without flowing past a sampling point established on a process effluent stream in accordance with this Regulation before being discharged.

(2) Each discharger shall report any concentration or other result that exceeds a limit prescribed by section 15 or 16.

(3) A report required under subsection (1) or (2) shall be given orally, as soon as reasonably possible, and in writing, as soon as reasonably possible.

Quarterly Reports to the Director

33.-(1) No later than forty-five days after the end of each quarter, each discharger shall submit a report to the Director containing information relating to the discharger's plant throughout the quarter as required by subsections (3) to (9).

(2) A report under this section shall be submitted both in an electronic format acceptable to the Director and in hard copy generated from the electronic format acceptable to the Director and signed by the discharger.

(3) A report under this section shall include all information included in a report given under section 32 during the quarter.

(4) Each discharger shall report, for each month in the quarter, the monthly average plant loadings and the highest and lowest daily plant loadings calculated under section 12 for each limited parameter and the quarterly plant loadings calculated under section 13 for each Schedule 3 assessment parameter.

(5) Each discharger shall report, for each month in the quarter, the monthly average concentration calculated under section 14 and the highest and lowest analytical results obtained under sections 18 and 19 for each limited parameter in each effluent monitoring stream at the discharger's plant.

(6) Each discharger shall report, for each month in the quarter, the monthly average process effluent plant volume and the

highest and lowest daily process effluent plant volumes calculated under section 27.

(7) Each discharger shall report, for each month in the quarter, the monthly building effluent plant volume calculated under section 27.

(8) Each discharger shall report the dates in each month in the quarter on which process effluent and by building effluent was discharged from the dischargers plant.

(9) Each discharger shall report, for each month in the quarter, the highest and lowest pH results obtained under section 21 for each process effluent monitoring stream at the discharger's plant.

Reports to the Director on Chronic Toxicity Testing

34.-(1) Each discharger shall report to the Director the results of all monitoring performed under section 24, together with the date on which each sample was picked-up, no later than sixty days after the end of each semi-annual period in which the monitoring was performed.

(2) A report under subsection (1) shall include a plot of percentage reduction in growth or reproduction against the logarithm of test concentration and shall include a calculation of the concentration at which a twenty-five percent reduction in growth or reproduction would occur.

PART IX - COMPLIANCE

Compliance Dates

35. Each discharger of a plant shall comply with,

(a) section 6 by January 1, 1998; (assumes January 1, 1995 filing)

(b) subsection 8(1) by _____, 199__;

(c) subsection 9(1) by _____, 199__;

(d) subsection 3(3) by _____*_, 199__; (Quench/Seal Water)

(e) Part IV by January 1, 1998 (assumes January 1, 1995 filing); and

(f) Part V and VI by _____, 199___.

(The date that is 90 days after the day on which this Regulation is filed will be inserted in subsection 35(f), 35(b) and 100 days after Regulation is filed will be inserted in subsection 35(c).)

***: January 1, 1997 ie. 1 year before section 6 activated**

PART X - REVOCATION

Revocation Provisions

36 -(1) Ontario Regulation 726/89 is revoked on ...., 199..

(The date that is 90 days after the day on which this Regulation is filed will be inserted in section 36.)

(2) Subsections 22(13), 22(14), 22(19) and 22(20) are revoked on ....., 199..**(insert first day of fourth year after filing)**

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Schedule 1

LIST OF REGULATED PLANTS

Plant Name	Location	Owner as of September 1, 1994
Fossil Subcategory		
Atikokan TGS	Atikokan	Ontario Hydro
J.C. Keith TGS	Windsor	Ontario Hydro
Lakeview TGS	Mississauga	Ontario Hydro
Lambton TGS	Courtright	Ontario Hydro
Lennox TGS	S.Fredricksburg	Ontario Hydro
Nanticoke TGS	Nanticoke	Ontario Hydro
R.L. Hearn TGS	Toronto	Ontario Hydro
Thunder Bay TGS	Thunder Bay	Ontario Hydro
Nuclear Subcategory		
Bruce NGS-A	Tiverton	Ontario Hydro
Bruce NGS-B	Tiverton	Ontario Hydro
Darlington NGS	Darlington	Ontario Hydro
Darlington NGS (Construction)	Darlington	Ontario Hydro
Pickering NGS-A and B	Pickering	Ontario Hydro
Associated Facilities		
Bruce Heavy Water Plant - Bruce Heavy Water Division	Tiverton	Ontario Hydro
Bruce Nuclear Power Development - Nuclear Waste & Environmental Services Division	Tiverton	Ontario Hydro

Legend: TGS = Thermal Generating Station (Fossil fuelled)
NGS = Nuclear Generating Station (Nuclear powered)

Schedule 2

Process Effluent Limits and Monitoring Frequency

PLANTS: All Plants Listed in Schedule 1 under Fossil Subcategory Effluent Streams: Ash Transport Water Effluent.				
ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
8	Total Suspended Solids	D	70.0	25.0
9	Aluminum*	W	13.0	4.50
9a	Iron	W	2.50	1.0

Explanatory notes:
D = Daily
W = Weekly
ATG = Analytical Test Group
mg/L = milligrams per litre
* = Applicable to all ash transport water effluent and effluent from those water treatment plants that use aluminum containing water treatment chemicals.

Schedule 2
Process Effluent Limits and Monitoring Frequency

PLANTS*: Lambton TGS, Lakeview TGS and Nanticoke TGS
Effluent Streams: Ash Quench Water and Boiler Seal Water or a combination of both.

ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
8	Total Suspended Solids	D	70.0	25.0
9	Aluminum	W	13.0	4.50
9a	Iron	W	2.50	1.0

Explanatory notes:
D = Daily
W = Weekly
ATG = Analytical Test Group
mg/L = milligrams per litre
* = Schedule effective on first day after two years from date of filing.

Schedule 2
Process Effluent Limits and Monitoring Frequency

PLANT: Lambton TGS
Effluent Stream: Coal Pile Effluent and Equipment Cleaning Effluent

ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
8	Total Suspended Solids (TSS)	W	70.0	25.0
9	Aluminum	W	13.0	4.50
9a	Iron	W	2.50	1.0

Explanatory notes:
D = Daily
W = Weekly
ATG = Analytical Test Group
mg/L = milligrams per litre

Schedule 2
Process Effluent Limits and Monitoring Frequency

PLANTS: All Plants Listed in Schedule 1
Effluent Stream: Coal Pile Effluent, Equipment Cleaning Effluent

ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
8	Total Suspended Solids (TSS)	D	25.0	25.0
9a	Iron	D	1.0	1.0

Explanatory notes:
D = Daily
ATG = Analytical Test Group
mg/L = milligrams per litre

Schedule 2

Process Effluent Limits and Monitoring Frequency

PLANTS: All Plants Listed in Schedule 1 under the Fossil Subcategory Effluent Streams: Oily Water Separators				
ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
25	Oil and Grease	W	29.0	13.0

Explanatory notes:
W = Weekly
ATG = Analytical Test Group
mg/L = milligrams per litre

Schedule 2
Process Effluent Limits and Monitoring Frequency

PLANTS: All Plants listed in Schedule 1 under Nuclear Subcategory Effluent Stream: Radioactive Liquid Waste Management System Tank Effluent				
ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
6	Total Phosphorus	W	-	1.0
8	Total Suspended Solids (TSS)	D	73.0	21.0
9	Zinc	W	1.0	0.50
9a	Iron	W	9.0	3.0
25	Oil and grease	W	36.0	13.0

Explanatory notes:
D = Daily
W = Weekly
ATG = Analytical Test Group
mg/L = milligrams per litre

Schedule 2

Process Effluent Limits and Monitoring Frequency

PLANTS: All Plants listed in Schedule 1 under Nuclear and Associated Subcategory
Effluent Streams: Oily Water Separators

ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
25	Oil and Grease	D	15.0	-

Explanatory notes:
D = Daily
ATG = Analytical Test Group
mg/L = milligrams per litre

Schedule 2

Process Effluent Limits and Monitoring Frequency

PLANTS: All Plants Listed in Schedule 1 under Nuclear Subcategory and Associated Facilities
Effluent Stream: Water Treatment Plant Effluent

ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
8	Total Suspended Solids	D	70.0	25.0
9	Aluminum*	W	13.0	4.50
9a	Iron	W	2.50	1.0

Explanatory notes:
D = Daily
W = Weekly
ATG = Analytical Test Group
mg/L = milligrams per litre
* = Applicable ony to effluent from those water treatment plants that use aluminum containing water treatment chemicals.

Schedule 2

Effluent Limits and Monitoring Frequency

PLANT: Bruce Heavy Water Plant, Bruce Heavy Water Division Effluent Streams: Process Effluent, Process Effluent Lagoon Effluent				
ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
15	Sulphide	D	0.8	-

Explanatory notes:
D = Daily
ATG = Analytical Test Group
mg/L = milligrams per litre

Schedule 2

Process Effluent Limits and Monitoring Frequency

PLANT: Darlington NGS
Effluent Streams: Industrial Sewage Treatment Plant Effluent

ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
1a	Biochemical Oxygen Demand (5 day)	W	-	25.0
4a	Ammonia plus Ammonium	W	-	7.0
6	Total phosphorus	W	-	4.6
8	Total Suspended solids	D	44.0	18.0
25	Oil and grease	W	38.0	12.0

Explanatory notes:
D = Daily
W = Weekly
ATG = Analytical Test Group
mg/L = milligrams per litre

Schedule 2

Process Effluent Limits and Monitoring Frequency

PLANT: Bruce Nuclear Power Development - Nuclear Waste & Environmental Services Division

Effluent Stream: Industrial Sewage Treatment Plant Effluent

ATG	Parameter	Monitoring Frequency	Daily Concentration Limit	Monthly Average Concentration Limit
			mg/L	mg/L
	Column 1	Column 2	Column 3	Column 4
1a	Biochemical Oxygen Demand (5 day)	W	-	25.0
4a	Ammonia plus Ammonium	W	-	7.0
6	Total phosphorus	W	-	1.0
8	Total Suspended solids	D	44.0	18.0
25	Oil and grease	W	38.0	12.0

Explanatory notes:
D = Daily
W = Weekly
ATG = Analytical Test Group
mg/L = milligrams per litre

Schedule 3

Building Effluent Assessment Monitoring Requirements

PLANTS: All Plants listed in Schedule 1		
ATG	Parameter	Monitoring Frequency
	Column 1	Columnn 2
8	Total Suspended Solids	Q
25	Oil and grease	Q

Explanatory notes:
Q = Quarterly
ATG = Analytical Test Group

Schedule 4

Storm Water Control Study

Assessment Monitoring Requirements

PLANTS: All Plants listed in Schedule 1	
ATG	Parameter
	Column 1
3	Hydrogen ion (pH)
8	Total Suspended Solids
9a	Iron
25	Oil and grease
27	Polychlorinated Biphenyls

Legend:

ATG = Analytical Test Group

Appendix B

Electric Power Generation Sector
Summary of MISA Monitoring Data

Appendix B
Summary of MISA Monitoring Data
Contents

Section		Page
B.1	Reporting	1
B.2	Database Size	1
B.3	Quality Assurance/Quality Control (QA/QC)	2
B.4	Presentation of Monitoring Data	2
B.5	References	4

List of Tables

Table		Page
1	Ash Transport(AT) Streams - Concentrations	5
2	Ash Transport(AT) Streams - Loadings	6
3	Coal Pile(CP) Streams - Concentrations	7
4	Coal Pile(CP) Streams - Loadings	8
5	Oily Water(OW) Streams - Concentrations	9
6	Oily Water(OW) Streams - Loadings	10
7	Water Treatment Plant Neutralization Sump(NS) -Concentrations	11
8	Water Treatment Plant Neutralization Sump(NS) - Loadings	12
9	Atikokan TGS - Station Direct Discharge Loadings	13
10	Lakeview TGS - Station Direct Discharge Loadings	14
11	Lambton TGS - Station Direct Discharge Loadings	15
12	Lennox TGS - Station Direct Discharge Loadings	16
13	Nanticoke TGS - Station Direct Discharge Loadings	17
14	Thunder Bay TGS - Station Direct Discharge Loadings	18
15	Annual Loadings from Fossil Stations	19
16	Radio-active Liquid Waste Management Tanks (RL) - Concentrations	20
17	Radio-active Liquid Waste Management Tanks (RL) - Loadings	21
18	Water Treatment Plant Neutralization Sump (NS) Streams - Concentrations	22
19	Water Treatment Plant Neutralization Sump (NS) Streams - Loadings	23
20	Oily Water (OW) Separator Streams - Concentrations	24
21	Bruce NGS-A - Direct Discharge Loadings	25
22	Bruce NGS-B - Direct Discharge Loadings	26
23	Darlington NGS - Direct Discharge Loadings	27
24	Pickering NGS -A/B - Direct Discharge Loadings	28
25	Annual Loadings from Nuclear Stations	29
26	Nuclear Associated Facilities - Process(PR) Effluent Streams - Concentrations	30

List of Tables (continued)

Table		Page
27	Nuclear Associated Facilities - Process(PR) Effluent Streams - Loadings	31
28	Darlington NGS (Under Construction) - Direct Discharge Loadings	32
29	Bruce Heavy Water Plant - Direct Discharge Loadings	33
30	BNPD Services - Direct Discharge Loadings	34
31	Annual Loadings from Nuclear Associated Facilities	35
32	Summary of Loadings from the EPGS Sector	36
33	Boiler Blowdown Streams - Concentrations	37
34	Fossil Stations - Building Effluent Streams - Concentrations	38
35	Hydraulic Stations - Building Effluent Streams - Concentrations	40
36	Nuclear Stations and Nuclear Associated Facilities - Building Effluent Streams - Concentrations	41
37	Fossil Stations - Intake (IN) and Outfall (OT) Once Through Cooling Water Streams - Concentrations	43
38	Nuclear Stations and Nuclear Associated Facilities - Intake (IN) and Outfall (OT) Once Through Cooling Water Streams - Concentrations	45
39	Hydraulic Stations - Intake (IN) and Transformer Once Through (OT) Cooling Water Streams - Concentrations	48
40	Emergency Overflows (EO) - Fossil Stations, Waste Disposal (WD) Streams -Nuclear Support Facilities - Concentrations	49
41	EPG Sector Equipment Cleaning (EC) Effluent - Concentrations	50
42	Fossil Stations - Storm Water Streams - Concentrations	53
43	Hydraulic Stations - Storm Water Streams - Concentrations	55
44	Nuclear Stations - Storm Water Streams - Concentrations	56
45	Nuclear Associated Facilities - Storm Water Streams - Concentrations	57
46	EPG Sector - Detection of Mercury	58
47	EPG Sector - Detection of Polychlorinated biphenyls (PCBs)	62
48	EPG Sector - Detection of Dioxins and Furans	64
49	EPG Sector - Detection of Arsenic	67
50	Summary of Monthly Maximum Temperature Data - Fossil Stations	69
51	Summary of Monthly Maximum Temperature Data - Nuclear Stations	72
52	Summary of Monthly Maximum Temperature Data - Bruce Heavy Water Plant	75
53	List of Monitoring Control Points	76
54	Parameter List	85

B MISA Monitoring Data

B.1 Reporting

Each sector plant site was required under the EPGS monitoring regulation to report results to the Ministry Regional Office within 60 to 90 days of sample collection using Ministry supplied computer diskettes customized for each plant in the sector. The diskettes were checked by Ministry regional operations prior to being transferred to the Ministry Sample Information System (SIS) database. Any corrections/resubmissions were handled in the same fashion.

B.2 Database Size

In total, approximately 430,000 data points were collected over the 12 month monitoring period. The following table provides a count of the concentration, flow and QA/QC data collected according to the effluent stream class. Intake data were provided voluntarily by some EPGS sites.

Count of Effluent Data According to Stream Class and Data Type
Effluent Concentration Data Include pH and Conductivity

Stream Class	Conc.	Flow	QA/QC	Temp.
AT - Ash Transport	26,684	5,581	2,478	N/A
BB - Boiler Blowdown	52,865	6,047	3,287	N/A
BE - Building Effluent	17,647	1,919	8	N/A
CP - Coal Pile Effluent	4,873	888	559	N/A
EC - Equipment Cleaning	2456	288	48	N/A
EO - Emergency Overflow	736	118	N/A	N/A
NS - Neutralization Sump	55,031	13,180	14,660	N/A
OT - Cooling Water	7554	4,082	285	31,983
OW - Oily Water Separator	16,135	6,178	3,749	N/A
PR - Process Effluent	41,159	9,979	6,970	N/A
RL - Radioactive Liquid Waste Tanks	12,715	2,852	7,643	N/A
SW - Storm Water	11,970	4,646	340	N/A
WD - Waste Disposal Site	728	96	N/A	N/A
RG - Rain Gauge	N/A	5,983	N/A	N/A
Total Effluent Data	**250,553**	**61,837**	**40,027**	**N/A**
IN - Intake	29,123	910	5,572	9,848
Total Monitoring Data	**279,676**	**62,747**	**45,599**	**41,831**
Grand Total = **429,853**				

N/A = Not Applicable

B.3 Quality Assurance/Quality Control (QA/QC)

In order to insure that the quality of the data collected were reliable, the monitoring regulation also required that the plant sites collect and analyze field and laboratory QA/QC samples. Field QA/QC samples included duplicate samples, travelling blank samples and travelling spiked blank samples which were collected on a monthly or quarterly basis, depending on the parameter.

A detailed assessment of the QA/QC data collected is contained in a separate report entitled: "Report on the Assessment of the Quality Assurance & Quality Control (QA/QC) Data for the Electric Power Generation Sector (EPGS)"[1]. The report evaluates and identifies effluent data which are unreliable or questionable.

Some primary concerns identified in the QA/QC report are:

- It was discovered during the monitoring period that samples collected using automatic samplers were subject to contamination[2] due to leaching of phenolics from sampler tubing and o-rings. Based on the levels of contamination found, data where the average concentration of phenolics (4AAP) is less than or equal to 5 ug/L are considered to be unreliable. Phenolics (4AAP) averages of less than or equal to 20 ug/L are considered to be overestimated. Phenolics (4AAP) results for effluents where the average was above 20 ug/L were accepted as reliable[1].

- Polychlorinated biphenyl (PCB) data collected at sixteen of the Ontario Hydro sites are considered to be overestimated due to high recoveries (average = 170%) from travelling spiked blank quality control samples. These sites are indicated in the sector summary table for PCBs (Table 47). All of these sites used a common laboratory for analysis of PCBs.

B.4 Presentation of Monitoring Data

Data collected for the EPGS are presented in table format at the back of this appendix.

Only "priority 1" parameters are included in the concentration and loading tables in this report unless specified otherwise. A parameter is designated as "priority 1" unless a statistically determined 0.90 proportion of the data are less than the RMDL for that particular parameter at a 95% confidence level.

The tabulated concentrations are arithmetic mean values. Loadings are mean daily figures calculated from the product of flow and concentration as recorded for each monitored day. Annual loadings ware calculated by summing, for each stream, the product of the number of days of effluent discharge and the average daily loading for a parameter. Typical daily loadings for a site were calculated by dividing the annual loadings by 365 days.

For process streams only, there was a legal obligation to report flow whenever one existed; therefore, annual loadings have been calculated using the frequency of flow reporting as the indicator of operational days. Annual loadings are calculated from the product of daily mean loading multiplied by the number of days of effluent discharge.

Loading values shown as "-" represent less than one gram per day or an absence of concentration or flow data from which to calculate loadings. Concentration/loading entries shown as "-" may also indicate that the parameter was not detected as a priority 1 parameter. Parameters detected less frequently than this were omitted on grounds that they were very likely results caused by very rare or events.

Concentration summary tables for special interest parameters such as PCBs, mercury, dioxins/furans and arsenic used a less selective inclusion criteria. Tables for these parameters present all data collected for an effluent where the parameter was detected at least once.

Units used for concentration data are as for the RMDLs listed on the tables. Units of flow are in cubic metres per 24 hour period of the monitoring day. Loadings are in kilograms per operating day unless otherwise stated.

The number of data points used in the calculation of mean values for a parameter may vary from 4 to 365. This affects the confidence limits which can be placed in the figures, more data implying narrower confidence limits. Conventional parameters such as suspended solids, etc., and flow had the most data points. The legally required frequencies of measurement are listed in the schedules in the monitoring regulation[3].

B.5 References

1. Environment Ontario, Electric Power Generation Sector (EPGS) Data Quality Evaluation Report (Draft), January 1993, unpublished.

2. Environment Ontario, Preliminary Investigation of Phenolic Contamination of Samples by Field Autosamplers, August 1992, ISBN 0-7778-0077-2.

3. Environment Ontario, The Development Document for the Effluent Monitoring Regulation for the Electric Power Generation Sector, February 1990, ISBN 0-7729-6553-6.

TABLE 1

EPG Sector – Fossil Fueled Stations – Concentrations
Ash Transport (AT) Streams – Units as per RMDL

		Station :	Atikokan TGS	Lakeview TGS	Lambton TGS	Nanticoke TGS	Nanticoke TGS	Thunder Bay TGS
		Control Point :	AT 0200	AT 0200	AT 0800	AT 0100	PR 0300	AT 0200
ATG	PARAMETER	RMDL						
1	COD	10 mg/L	14.8	–	–	–	–	29.6
2	Cyanide Total	0.005 mg/L	–	0.01	–	–	–	–
3	pH		7.9	9.1	7.44	10.7	8.19	7.27
4	Ammonia plus Ammonium	0.25 mg/L	0.994	–	–	5.97	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	0.819	0.735	–	7.41	0.762	0.661
	Nitrate+Nitrite	0.25 mg/L	–	0.97	0.469	0.363	1.23	–
5	DOC	0.5 mg/L	6.06	3.36	2.08	1.27	3.09	11.6
	TOC	5 mg/L	6.46	–	–	–	3.56	12.6
6	Total phosphorus	0.1 mg/L	0.235	0.081	2.28	–	0.114	0.071
7	Conductance	uS/cm	268	618	428	855	523	264
8	Total suspended solids	5 mg/L	10.8	14.3	10.5	17.2 †	102	10.5
9	Aluminum	30 ug/L	2200	649	504	1220	1930	1010
	Boron	50 ug/L	179	142	47.3	1770	126	186
	Cadmium	2 ug/L	2.04	2.2	2.33	2.31	2.18	2.27
	Chromium	20 ug/L	–	–	–	42.9	–	20.8
	Copper	10 ug/L	7.71	9.39	11.1	6.38	11.7	16.8
	Lithium	50 ug/L	–	33.8	–	244	–	–
	Molybdenum	20 ug/L	20.8	–	–	184	–	–
	Nickel	20 ug/L	21.5	–	–	–	–	24
	Strontium	20 ug/L	427	243	163	2000	4940	486
	Vanadium	30 ug/L	–	–	–	101	–	–
	Zinc	10 ug/L	12.2	8.83	13.8	–	73.9	18.8
E1	Iron, Unfiltered Total	20 ug/L	369	259	226	41.3	1530	520
10	Antimony	5 ug/L	–	–	–	5.78	–	–
	Arsenic	5 ug/L	–	8.91	–	–	–	–
	Selenium	5 ug/L	–	–	–	48.9	–	–
11	Chromium (hexavalent)	10 ug/L	8.94	–	–	–	–	–
12	Mercury	0.1 ug/L	0.119	–	–	–	–	0.281
14	Phenolics (4AAP)	2 ug/L	100	–	–	2.02	–	45
16	Bromodichloromethane	0.8 ug/L	–	1.41	–	–	–	–
	Chloroform	0.7 ug/L	–	5.6	–	–	–	13.7
	Methylene chloride	1.3 ug/L	4.24	–	–	–	–	3.71
	Trichlorofluoromethane	1 ug/L	–	–	1.21	–	–	–
17	Toluene	0.5 ug/L	–	–	–	–	–	4.43
25	Oil and grease	1 mg/L	2.11	–	1.68	1.06	1.88	1.6
	Flow	m^3/day	2030	4260	2320	42900 †	1170	2650

Note: All flows are continuous except PR 0300 at Nanticoke TGS.
PR 0300 is a control point where backflush water from the ash transport line is sampled.

† Nanticoke ash transport water system was changed in January 1993. Average flow measured over the period. Jan/93 – May/93 was 14,534 m^3/day. Average TSS concentration was 5.5 mg/L, maximum was 33 mg/L.

TABLE 2

EPG Sector – Fossil Fueled Stations – Loadings (kg/day)
Ash Transport (AT) Streams

	Station :	Atikokan TGS	Lakeview TGS	Lambton TGS	Nanticoke TGS	Nanticoke TGS	Thunder Bay TGS
	Control Point :	AT 0200	AT 0200	AT 0800	AT 0100	PR 0300	AT 0200
ATG	PARAMETER						
1	COD	22.9	–	–	–	–	113
2	Cyanide Total	–	0.034	–	–	–	–
4	Ammonia plus Ammonium	2.24	–	–	254	–	–
	Nitrate+Nitrite	–	4.2	1.08	15.7	1.42	–
	Total Kjeldahl nitrogen	1.67	3.22	–	351	0.684	1.71
5	DOC	12.1	15.1	4.96	53.2	3.46	32.1
	TOC	12.8	–	–	–	4.61	34.8
6	Total phosphorus	0.514	0.332	3.95	–	0.115	0.192
8	Total suspended solids	22.9	68.9	24.6	830	167	28.1
9	Aluminum	4.83	2.71	0.882	53.4	2.04	2.73
	Boron	0.379	0.567	0.108	76.4	0.1	0.461
	Cadmium	0.004	0.009	0.005	0.092	0.002	0.006
	Chromium	–	–	–	1.88	–	0.056
	Copper	0.013	0.042	0.027	0.255	0.012	0.043
	Lithium	–	0.143	–	10.5	–	–
	Molybdenum	0.042	–	–	7.96	–	–
	Nickel	0.041	–	–	–	–	0.065
	Strontium	0.926	0.972	0.385	87.3	5.49	1.32
	Vanadium	–	–	–	4.37	–	–
	Zinc	0.02	0.041	0.038	–	0.091	0.055
E1	Iron, Unfiltered Total	0.572	1.25	0.502	1.92	2.01	1.43
10	Antimony	–	–	–	0.239	–	–
	Arsenic	–	0.037	–	–	–	–
	Selenium	–	–	–	2.14	–	–
11	Chromium (hexavalent)	0.019	–	–	–	–	–
12	Mercury	–	–	–	–	–	0.001
14	Phenolics (4AAP)	0.209	–	–	0.068	–	0.165
16	Bromodichloromethane	–	0.005	–	–	–	–
	Chloroform	–	0.018	–	–	–	0.04
	Methylene chloride	0.01	–	–	–	–	0.01
	Trichlorofluoromethane	–	–	0.003	–	–	–
17	Toluene	–	–	–	–	–	0.014
25	Oil and grease	4.9	–	3.54	43.8	2.34	4.32

Note: All flows are continuous except PR 0300 at Nanticoke TGS.
PR 0300 is a control point for sampling of backflush water from the ash transport line.
Loadings less than 0.001 kg/day are not shown.

TABLE 3

EPG Sector – Fossil Fueled Stations – Concentrations
Coal Pile (CP) Streams – Units as per RMDL

	Station	Atikokan TGS	Lakeview TGS	Lakeview TGS	Lambton TGS	Lambton TGS	Nanticoke TGS	Nanticoke TGS	Thunder Bay TGS
	Control Point :	CP 0400	CP 1700	CP 1800	CP 1000	CP 1100	CP 2000	CP 2100	CP 0700
ATG	PARAMETER	RMDL							
1	COD	10 mg/L	–	–	30	–	–	–	–	–
3	pH		7.9	7.31	8.55	4.17	7.91	7.79	7.84	7.52
4	Ammonia plus Ammonium	0.25 mg/L	6.27	0.387	2.29	0.309	–	–	0.288	–
	Total Kjeldahl nitrogen	0.5 mg/L	2.17	6.72	2.55	0.602	–	5.75	1.5	1.49
	Nitrate+Nitrite	0.25 mg/L	–	0.612	1.03	0.284	–	0.418	0.778	–
5	DOC	0.5 mg/L	76.7	9.73	3.78	2.59	2.27	3.63	3.48	6.23
	TOC	5 mg/L	83.1	25.5	–	–	–	43.4	7.01	7.94
6	Total phosphorus	0.1 mg/L	0.55	0.19	–	0.232	0.125	0.463	0.206	–
7	Conductance	uS/cm	235	1670	1580	1980	2190	1080	1010	665
8	Total suspended solids	5 mg/L	1240	555	11.9	9720	6.83	1480	314	44.9
9	Aluminum	30 ug/L	11400	873	279	14300	200	4600	2070	1510
	Boron	50 ug/L	897	881	704	1610	13900	184	261	2220
	Cadmium	2 ug/L	2.71	2.37	2.56	3.28	–	3.42	3.5	5.08
	Chromium	20 ug/L	–	–	–	–	–	–	–	20.8
	Cobalt	20 ug/L	–	28.8	–	48	–	–	–	–
	Copper	10 ug/L	46.9	20.4	11.1	181	9.58	42.8	17.8	13.8
	Lead	30 ug/L	55.7	–	–	–	–	–	–	40
	Lithium	50 ug/L	–	143	119	150	1230	–	–	–
	Molybdenum	20 ug/L	–	22.5	18.9	–	184	–	–	–
	Nickel	20 ug/L	31.4	55	22.2	91.3	–	20.8	–	47.5
	Strontium	20 ug/L	875	1470	1300	3280	4410	2400	2340	787
	Thallium	30 ug/L	–	–	–	103	–	–	–	–
	Zinc	10 ug/L	53	231	13.5	519	11.6	64.1	70.6	23.4
E1	Iron, Unfiltered Total	20 ug/L	5150	5300	365	50800	268	8580	3650	12300
10	Arsenic	5 ug/L	–	9.21	–	–	–	8.35	5	–
11	Chromium (hexavalent)	10 ug/L	32.2	–	–	13.9	–	–	–	–
12	Mercury	0.1 ug/L	–	0.097	–	–	0.122	0.154	–	0.167
14	Phenolics (4AAP)	2 ug/L	12.6	–	–	–	–	–	–	12.8
25	Oil and grease	1 mg/L	1.07	18.9	3.42	6.54	6.52	7.77	2.86	5.43
	Flow	m^3/day or event	11.7	1530	2940	2650	157	39854	3200	319

Note : Underlined Control Points were monitored once per month, are upstream of direct discharges and are further treated. Flows are aproximate averages.

TABLE 4

EPG Sector – Fossil Fueled Stations – Loadings (kg/day or event)
Coal Pile (CP) Streams

	Station :	Atikokan TGS	Lakeview TGS	Lakeview TGS	Lambton TGS	Lambton TGS	Nanticoke TGS	Nanticoke TGS	Thunder Bay TGS
	Control Point :	CP 0400	CP 1700	CP 1800	CP 1000	CP 1100	CP 2000	CP 2100	CP 0700
ATG	PARAMETER								
1	COD	–	–	90	–	–	–	–	–
4	Ammonia plus Ammonium	0.1	0.7	8	0.6	–	–	0.9	–
	Total Kjeldahl nitrogen	0.009	29	8	2	–	200	6	0.6
	Nitrate+Nitrite	–	1	3	0.9	–	10	3	–
5	DOC	1	5	11	8	0.3	100	10	2
	TOC	1	32	–	–	–	2000	19	3
6	Total phosphorus	0.008	0.5	–	0.4	0.02	10	0.5	–
8	Total suspended solids	1	3000	33	5000	1	40000	900	20
9	Aluminum	0.1	2	0.8	22	0.03	200	7	0.8
	Boron	0.008	1	2	3	3	9	0.7	0.7
	Cadmium	–	0.003	0.007	0.008	–	0.06	0.01	0.001
	Chromium	–	–	–	–	–	–	–	0.007
	Cobalt	–	0.06	–	0.1	–	–	–	–
	Copper	–	0.06	0.03	0.2	0.002	2	0.07	0.005
	Lead	–	–	–	–	–	–	–	0.01
	Lithium	–	0.2	0.4	0.3	0.2	–	–	–
	Molybdenum	–	0.04	0.06	–	0.03	–	–	–
	Nickel	–	0.1	0.07	0.2	–	0.6	–	0.02
	Strontium	0.006	2	4	5	0.8	200	8	0.3
	Thallium	–	–	–	0.2	–	–	–	–
	Zinc	–	0.4	0.04	2	0.002	3	0.3	0.01
E1	Iron, Unfiltered Total	0.03	13	1	57	0.5	300	12	2
10	Arsenic	–	0.03	–	–	–	0.2	0.01	–
11	Chromium (hexavalent)	–	–	–	0.02	–	–	–	–
12	Mercury	–	–	–	–	–	0.006	–	–
14	Phenolics (4AAP)	–	–	–	–	–	–	–	0.004
25	Oil and grease	0.02	30	9	15	1	200	9	0.6
	Average Volume m^3/day or event	11.7	1530	2940	2400	157	39900	3200	319
	Number of Discharge Volumes Measured	4	12	14	11	248	10	10	365

Note :
Loadings less than 0.001 kg/day are not shown.
Underlined control points are upstream of direct discharges and are further treated.
Loadings from coal pile effluents are highly dependant on storm intensity and duration;consequently the data have been rounded off to one significant figure.
Use data with caution: Loadings are typical and should not be extrapolated to annual loadings.
Coal pile effluent is typically discharged intermittently. Sites were required to monitor one discharge per month.
Lambton CP 1100 discharged continuously over 248 days during the monitoring period and measured all flow volumes.
Thunder Bay CP 0700 discharged, on average, 12.5 hours per day over the monitoring period and measured all flow volumes.

TABLE 5

EPG Sector – Fossil Fueled Stations – Concentrations
Oily Water (OW) Streams – Units as per RMDL

		Station:	Atikokan TGS	Lakeview TGS	Lakeview TGS	Lennox TGS	Thunder Bay TGS
		Control Point:	OW 0600	OW 2300	OW 2400	OW 0300	OW 1100
ATG	PARAMETER	RMDL					
1	COD	10 mg/L	14	35	23.8	16	28.4
3	pH		7.83	7.72	7.89	8.31	7.48
4	Ammonia plus Ammonium	0.25 mg/L	1.42	–	–	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	1.36	–	–	0.479	0.965
	Nitrate+Nitrite	0.25 mg/L	–	–	0.32	0.399	0.302
5	DOC	0.5 mg/L	6.7	4.33	4.67	4.21	10.6
	TOC	5 mg/L	5.74	9.93	6.6	5.17	11.4
6	Total phosphorus	0.1 mg/L	0.209	0.122	–	0.128	–
7	Conductance	uS/cm	108	188	399	357	130
8	Total suspended solids	5 mg/L	–	13.2	7.21	–	6.13
9	Aluminum	30 ug/L	40	172	82.2	52.6	328
	Cadmium	2 ug/L	–	2.07	2.46	2.93	–
	Copper	10 ug/L	–	34.7	14.3	15.4	27.8
	Molybdenum	20 ug/L	–	–	–	–	82.5
	Nickel	20 ug/L	21	–	–	–	–
	Strontium	20 ug/L	46.2	104	207	1140	23.9
	Zinc	10 ug/L	–	38.5	15.6	15	17.5
E1	Iron, Unfiltered Total	20 ug/L	45.5	336	247	166	489
14	Phenolics (4AAP)	2 ug/L	57.8	4.31	3.81	13.4	43.4
16	1,1–Dichloroethane	0.8 ug/L	–	0.655	1.67	–	–
	Chloroform	0.7 ug/L	–	1.62	0.722	–	11.6
	Methylene chloride	1.3 ug/L	4.28	–	–	–	5.47
	Trichlorofluoromethane	1 ug/L	2.8	–	–	–	–
19	Bis(2–ethylhexyl) phthalate	2.2 ug/L	–	6.65	–	–	–
25	Oil and grease	1 mg/L	1.79	13.3	6.38	1.97	2.44
27	PCBT	0.1 ug/L	–	–	0.085	–	–
	Flow	m^3/day	1210	33.3	12.3	950.0	180.0

TABLE 6

EPG Sector – Fossil Fueled Stations – Loadings (kg/day)
Oily Water (OW) Streams

	Station :	Atikokan TGS	Lakeview TGS	Lakeview TGS	Lennox TGS	Thunder Bay TGS
	Control Point :	OW 0600	OW 2300	OW 2400	OW 0300	OW 1100
ATG	PARAMETER					
1	COD	18.3	0.742	0.258	11.3	5.38
4	Ammonia plus Ammonium	2.45	–	–	–	–
	Total Kjeldahl nitrogen	2.36	–	–	0.325	0.185
	Nitrate+Nitrite	–	–	0.005	0.291	0.053
5	DOC	8.11	0.145	0.056	4	1.91
	TOC	6.24	0.337	0.13	4.83	2.06
6	Total phosphorus	0.278	0.004	–	0.097	–
8	Total suspended solids	–	0.468	0.097	–	1.12
9	Aluminum	0.062	0.005	0.001	0.041	0.06
	Cadmium	–	–	–	0.002	–
	Copper	–	0.001	–	0.015	0.005
	Molybdenum	–	–	–	–	0.016
	Nickel	0.029	–	–	–	–
	Strontium	0.069	0.004	0.003	0.934	0.004
	Zinc	–	0.001	–	0.012	0.003
E1	Iron, Unfiltered Total	0.09	0.011	0.003	0.144	0.089
14	Phenolics (4AAP)	0.073	–	–	0.0141	0.008
16	Chloroform	–	–	–	–	0.002
	Methylene chloride	0.004	–	–	–	0.001
	Trichlorofluoromethane	0.005	–	–	–	–
25	Oil and grease	2.08	0.444	0.084	1.87	0.455

Note:
Loadings less than 0.001 kg/day are not shown.

TABLE 7

EPG Sector – Fossil Fueled Stations – Concentrations
Water Treatment Plant (WTP) – Neutralization Sump (NS) Streams
Units as per RMDL

	Station :	Atikokan TGS	Lakeview TGS	Lambton TGS	Lennox TGS	Nanticoke TGS	Thunder Bay TGS
	Control Point :	NS 0800	NS 2700	NS 1200	NS 2300	NS 2800	NS 1500
ATG PARAMETER	RMDL						
1 COD	10 mg/L	27.6	16.5	–	27	22.3	16.5
2 Cyanide Total	0.005 mg/L	–	–	–	–	0.012	–
3 pH		7.09	5.09	6.33	7.71	5.74	5.25
4 Ammonia plus Ammonium	0.25 mg/L	2.33	0.153	–	0.336	–	0.507
Total Kjeldahl nitrogen	0.5 mg/L	2.46	0.837	–	0.886	1.06	1.89
Nitrate+Nitrite	0.25 mg/L	0.188	1.09	0.737	0.826	0.911	0.202
5 DOC	0.5 mg/L	9.24	6.28	3.31	7.46	7.16	11.1
TOC	5 mg/L	11.1	6.72	4.02	7.92	8.22	12.3
6 Total phosphorus	0.1 mg/L	0.268	0.181	0.222	0.158	0.093	0.062
7 Conductance	uS/cm	4250	2090	1370	2030	1690	4960
8 Total suspended solids	5 mg/L	14.8	371	644	4.95	323	13.6
9 Aluminum	30 ug/L	1420	1350	424	69.2	665	1090
Boron	50 ug/L	149	66.7	–	67.7	77	63.4
Cadmium	2 ug/L	3.7	3.06	3.28	3.93	3.06	2.39
Chromium	20 ug/L	22.6	–	–	–	–	26.3
Copper	10 ug/L	22.6	28.2	31.2	20.4	31.8	84.2
Lead	30 ug/L	30.7	–	–	–	–	30.3
Molybdenum	20 ug/L	37.5	–	–	–	–	142
Nickel	20 ug/L	49.4	–	–	–	1.08	38
Strontium	20 ug/L	286	454	288	339	545	98.4
Zinc	10 ug/L	35	24.8	31.4	11	24	30.8
E1 Iron, Unfiltered Total	20 ug/L	1760	1140	3260	466	1160	728
12 Mercury	0.1 ug/L	2.38	0.131	0.088	0.2	0.095	1.99
14 Phenolics (4AAP)	2 ug/L	67.8	–	4.41	7.95	2.5	33.7
15 Sulphide	0.02 mg/L	–	–	–	0.093	–	–
16 Trichlorofluoromethane	1 ug/L	–	–	1.27	–	–	–
Bromodichloromethane	0.8 ug/L	–	6.62	–	–	1.08	–
Chloroform	0.7 ug/L	8.91	35.6	–	1.93	7.35	22.6
25 Oil and grease	1 mg/L	2.1	0.706	3.88	1.28	1.83	1.45
Flow	m^3/day	235	1050	1550	486	1290	250

Note : Underlined control points are upstream of direct discharges and are further treated.

TABLE 8

EPG Sector – Fossil Fueled Stations – Loadings (kg/day)
Water Treatment Plant (WTP) Neutralization Sump (NS) Streams

	Station :	Atikokan TGS	Lakeview TGS	Lambton TGS	Lennox TGS	Nanticoke TGS	Thunder Bay TGS
	Control Point :	NS 0800	NS 2700	NS 1200	NS 2300	NS 2800	NS 1500
ATG	PARAMETER						
1	COD	6.8	11.1	–	15.1	43.9	4.85
2	Cyanide Total	–	–	–	–	0.019	–
4	Ammonia plus Ammonium	0.588	0.118	–	0.143	–	0.084
	Total Kjeldahl nitrogen	0.554	0.69	–	0.375	1.3	0.311
	Nitrate+Nitrite	0.047	0.832	1.14	0.383	1.11	0.058
5	DOC	2.24	5.35	5.09	3.81	10	3.25
	TOC	2.82	5.67	6.26	4.04	10.4	3.71
6	Total phosphorus	0.067	0.125	0.318	0.073	0.128	0.012
8	Total suspended solids	3.68	291	1140	2.61	516	5.56
9	Aluminum	0.376	0.986	0.761	0.031	1.05	0.249
	Boron	0.037	0.056	–	0.031	0.094	0.015
	Cadmium	0.001	0.004	0.005	0.002	0.004	0.001
	Chromium	0.005	–	–	–	–	0.006
	Copper	0.005	0.029	0.049	0.011	0.045	0.03
	Lead	0.008	–	–	–	–	0.008
	Molybdenum	0.009	–	–	–	–	0.028
	Nickel	0.012	–	–	–	–	0.008
	Strontium	0.071	0.366	0.501	0.151	0.661	0.04
	Zinc	0.008	0.02	0.051	0.006	0.031	0.006
E1	Iron, Unfiltered Total	0.43	0.841	5.34	0.24	1.63	0.135
12	Mercury	0.001	–	–	–	–	–
14	Phenolics (4AAP)	0.017	–	0.007	0.0047	0.003	0.003
15	Sulphide	–	–	–	0.11	–	–
16	Bromodichloromethane	–	0.006	–	–	0.001	–
	Chloroform	0.002	0.03	–	0.001	0.009	0.007
	Trichlorofluoromethane	–	–	0.002	–	–	–
25	Oil and grease	0.534	0.812	5.42	0.599	2.18	0.303

Note: Underlined control points are upstream of direct discharges and are further treated.
Loadings less–than 0.001 kg/day are not shown.

TABLE 9

EPG Sector
Atikokan TGS – Direct Discharge Loadings

	Control Point:	AT 0200	BB 0300	NS 0800	OW 0600	*Total* Daily	Annual
		kg/day	kg/day	kg/day	kg/day	kg/day	kg/year
ATG	PARAMETER		(1 boiler)				
1	COD	22.9	–	6.8	18.3	42	15300
4	Ammonia plus Ammonium	2.24	0.0954	0.588	2.45	4.77	1740
	Total Kjeldahl nitrogen	1.67	0.08	0.554	2.36	4.13	1510
	Nitrate+Nitrite	–	–	0.047	–	0.0153	5.59
5	DOC	12.1	0.153	2.24	8.11	20.3	7390
	TOC	12.8	–	2.82	6.24	19.2	7010
6	Total phosphorus	0.514	0.012	0.067	0.278	0.786	287
8	Total suspended solids	22.9	–	3.68	–	22.8	8320
9	Aluminum	4.83	0.0043	0.376	0.062	4.74	1730
	Boron	0.379	–	0.037	–	0.369	135
	Cadmium	0.004	–	0.001	–	0.0041	1.5
	Chromium	–	–	0.005	–	0.00163	0.595
	Copper	0.013	0.001	0.005	–	0.0141	5.15
	Lead	–	–	0.008	–	0.00261	0.952
	Molybdenum	0.042	0.0021	0.009	–	0.043	15.7
	Nickel	0.041	–	0.012	0.029	0.0715	26.1
	Strontium	0.926	–	0.071	0.069	0.965	352
	Zinc	0.02	0.0024	0.008	–	0.022	8.02
E1	Iron, Unfiltered Total	0.572	0.0715	0.43	0.09	0.785	286
11	Chromium (hexavalent)	0.019	–	–	–	0.0179	6.54
12	Mercury	–	–	0.001	–	–	0.119
14	Phenolics (4AAP)	0.209	0.006	0.017	0.073	0.277	101
16	Chloroform	–	–	0.002	–	–	0.238
	Methylene chloride	0.01	–	–	0.004	0.0134	4.9
	Trichlorofluoromethane	–	–	–	0.005	0.00499	1.82
25	Oil and grease	4.9	0.0952	0.534	2.08	6.89	2510
	Days of Discharge	344	79	119	364		

Note: Total annual loadings are calculated based on number of days of discharge.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings for the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 10

EPG Sector
Lakeview TGS – Direct Discharge Loadings

	Control Point:	AT 0200	BB	OW 2300	OW 2400	*Total* Daily	*Total* Annual
		kg/day	kg/day	kg/day	kg/day	kg/day	kg/year
ATG	PARAMETER		(8 boilers)				
1	COD	–	–	0.742	0.258	0.989	361
2	Cyanide Total	0.034	–	–	–	0.0333	12.2
4	Total Kjeldahl nitrogen	3.22	–	–	–	3.16	1150
	Nitrate+Nitrite	4.2	–	–	0.005	4.12	1510
5	DOC	15.1	6.27	0.145	0.056	19	6950
	TOC	–	–	0.337	0.13	0.462	169
6	Total phosphorus	0.332	1.32	0.004	–	1.18	431
8	Total suspended solids	68.9	–	0.468	0.097	68.1	24900
	Volatile suspended solids	–	–	0.31	–	0.307	112
9	Aluminum	2.71	0.208	0.005	0.001	2.8	1020
	Boron	0.567	–	–	–	0.556	203
	Cadmium	0.009	0.008	–	–	0.014	5.1
	Copper	0.042	0.328	0.001	–	0.253	92.5
	Lithium	0.143	–	–	–	0.14	51.2
	Molybdenum	–	0.064	–	–	0.0412	15
	Nickel	–	0.56	–	–	0.361	132
	Strontium	0.972	–	0.004	0.003	0.96	351
	Zinc	0.041	0.04	0.001	–	0.067	24.4
E1	Iron, Unfiltered Total	1.25	0.096	0.011	0.003	1.3	475
10	Arsenic	0.037	–	–	–	0.0363	13.2
14	Phenolics (4AAP)	–	0.032	–	–	0.0206	7.52
16	Bromodichloromethane	0.005	–	–	–	0.0049	1.79
	Chloroform	0.018	–	–	–	0.0177	6.44
25	Oil and grease	–	–	0.444	0.084	0.522	191
	Days of Discharge	358	235	361	361		

Note: Total annual loadings are calculated based on number of days of discharge.
Boiler Blowdown (BB) loading is average loading of all of the boilers multiplied by No. of Boilers
Loadings from boiler blowdown are overestimated because not all 8 boilers discharged on each of the 235 days of discharge.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings for the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 11

EPG Sector
Lambton TGS – Direct Discharge Loadings

	Control Point:	AT 0800 kg/day	BB kg/day (4 boilers)	Total Daily kg/day	Total Annual kg/day
ATG	PARAMETER				
4	Ammonia plus Ammonium	–	0.156	0.141	51.5
	Nitrate+Nitrite	1.08	–	1.08	394
5	DOC	4.96	0.812	5.69	2080
6	Total phosphorus	3.95	1.72	5.51	2010
8	Total suspended solids	24.6	30.2	51.9	18900
9	Aluminum	0.882	0.152	1.02	372
	Boron	0.108	–	0.108	39.4
	Cadmium	0.005	0.004	0.00862	3.15
	Copper	0.027	0.148	0.161	58.7
	Strontium	0.385	–	0.385	141
	Zinc	0.038	0.02	0.0561	20.5
E1	Iron, Unfiltered Total	0.502	0.088	0.582	212
14	Phenolics (4AAP)	–	0.008	0.00723	2.64
16	Trichlorofluoromethane	0.003	–	0.003	1.1
25	Oil and grease	3.54	2.02	5.37	1960
	Days of Discharge	365	330		

Note: Total annual loadings are calculated based on number of days of discharge.
Boiler Blowdown (BB) loading is the average loading of all of the boilers multiplied by No. of boilers.
Loadings from boiler blowdown are overestimated because not all 4 boilers discharged on each of the 330 days of discharge.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings for the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 12

EPG Sector
Lennox TGS – Direct Discharge Loadings

	Control Point:	BB	NS 2300	OW 0300	Total Daily	Total Annual
		kg/day	kg/day	kg/day	kg/day	kg/year
ATG	PARAMETER	(4 boilers)				
1	COD	–	15.1	11.3	23.1	8450
4	Ammonia plus Ammonium	0.696	0.143	–	0.722	263
	Total Kjeldahl nitrogen	–	0.375	0.325	0.607	222
	Nitrate+Nitrite	–	0.383	0.291	0.59	215
5	DOC	4.76	3.81	4	10.6	3880
	TOC	–	4.04	4.83	7.5	2740
6	Total phosphorus	0.696	0.073	0.097	0.722	264
8	Total suspended solids	–	2.61	–	2.59	945
9	Aluminum	0.168	0.031	0.041	0.2	73.1
	Boron	–	0.031	–	0.0307	11.2
	Cadmium	0.012	0.002	0.002	0.0134	4.9
	Copper	0.096	0.011	0.015	0.102	37.1
	Strontium	–	0.151	0.934	0.825	301
	Zinc	0.028	0.006	0.012	0.038	13.9
E1	Iron, Unfiltered Total	0.044	0.24	0.144	0.379	138
14	Phenolics (4AAP)	0.012	0.0047	0.0141	0.0249	9.07
15	Sulphide	–	0.11	–	0.109	39.8
16	Chloroform	–	0.001	–	–	0.362
25	Oil and grease	–	0.599	1.87	1.95	711
	Days of Discharge	304	362	264		

Note: Total annual loadings are calculated based on number of days of discharge.
Boiler Blowdown (BB) loading is average loading of all of the boilers multiplied by No. of boilers.
Loadings from boiler blowdown are overestimated because not all 4 boilers discharged on each of the 304 days of discharge.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings for the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 13

EPG Sector
Nanticoke TGS – Direct Discharge Loadings

	Control Point:	AT 0100 kg/day	BB kg/day (8 boilers)	PR 0300 kg/day	Total Daily kg/day	Total Annual kg/year
ATG	PARAMETER					
4	Ammonia plus Ammonium	254	0.0532	–	254	92700
	Total Kjeldahl nitrogen	351	–	0.684	351	128000
	Nitrate+Nitrite	15.7	–	1.42	16.6	6040
5	DOC	53.2	–	3.46	55.3	20200
	TOC	–	–	4.61	2.79	1020
6	Total phosphorus	–	0.126	0.115	0.183	66.9
8	Total suspended solids	830	1.77	167	933	340000
9	Aluminum	53.4	0.027	2.04	54.7	20000
	Boron	76.4	–	0.1	76.5	27900
	Cadmium	0.092	0.004	0.002	0.0968	35.3
	Chromium	1.88	–	–	1.88	686
	Copper	0.255	0.167	0.012	0.413	151
	Lithium	10.5	–	–	10.5	3830
	Molybdenum	7.96	0.0119	–	7.97	2910
	Nickel	–	0.0473	–	0.0426	15.6
	Strontium	87.3	–	5.49	90.6	33100
	Vanadium	4.37	–	–	4.37	1600
	Zinc	–	0.00866	0.091	0.0629	23
B1	Iron, Unfiltered Total	1.92	0.0167	2.01	3.15	1150
10	Antimony	0.239	–	–	0.239	87.2
	Selenium	2.14	–	–	2.14	781
14	Phenolics (4AAP)	0.068	0.0049	–	0.0724	26.4
25	Oil and grease	43.8	–	2.34	45.2	16500
	Days of Discharge	365	329	221		

Note: Total annual loadings are calculated based on No. of days of discharge.
Boiler Blowdown (BB) is average loading of all of the boilers multiplied by No. of boilers.
Loadings from boiler blowdown are overestimated because not all 8 boilers discharged on each of the 329 days of discharge
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings for the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 14

EPG Sector
Thunder Bay TGS – Station Direct Discharge Loadings

	Control Point:	AT 0200	BB	NS 1500	OW 1100	*Totals* Daily	Annual
		kg/day	kg/day	kg/day	kg/day	kg/day	kg/year
ATG	PARAMETER		(2 boilers)				
1	COD	113	–	4.85	5.38	117	42700
4	Ammonia plus Ammonium	–	0.086	0.084	–	0.092	33.6
	Total Kjeldahl nitrogen	1.71	0.192	0.311	0.185	2.02	737
	Nitrate+Nitrite	–	–	0.058	0.053	0.0508	18.6
5	DOC	32.1	–	3.25	1.91	34.9	12700
	TOC	34.8	–	3.71	2.06	38	13900
6	Total phosphorus	0.192	0.034	0.012	–	0.209	76.4
8	Total suspended solids	28.1	–	5.56	1.12	32.9	12000
9	Aluminum	2.73	0.008	0.249	0.06	2.94	1070
	Boron	0.461	–	0.015	–	0.473	173
	Cadmium	0.006	–	0.001	–	0.00686	2.5
	Chromium	0.056	–	0.006	–	0.0611	22.3
	Copper	0.043	0.002	0.03	0.005	0.0696	25.4
	Lead	–	–	0.008	–	0.00701	2.56
	Molybdenum	–	0.006	0.028	0.016	0.0258	9.43
	Nickel	0.065	–	0.008	–	0.0718	26.2
	Strontium	1.32	–	0.04	0.004	1.35	493
	Zinc	0.055	0.004	0.006	0.003	0.061	22.3
E1	Iron, Unfiltered Total	1.43	0.042	0.135	0.089	1.55	567
12	Mercury	0.001	–	–	–	–	0.364
14	Phenolics (4AAP)	0.165	0.006	0.003	0.008	0.168	61.5
16	Chloroform	0.04	–	0.007	0.002	0.046	16.8
	Methylene chloride	0.01	–	–	0.001	0.00997	3.64
17	Toluene	0.014	–	–	–	0.014	5.1
25	Oil and grease	4.32	–	0.303	0.455	4.57	1670
	Days of Discharge	364	78	320	365		

Note: Total annual loadings are calculated based on number of days of discharge.
Boiler Blowdown (BB) loading is average loading of all of the boilers multiplied by No. of boilers.
Loadings from boiler blowdown are overestimated because not all boilers discharged on each of the 78 days of discharge.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings for the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 15
Annual Loadings from Fossil Stations (kg/year)

ATG	PARAMETER	Atikokan TGS	Lakeview TGS	Lambton TGS	Lennox TGS	Nanticoke TGS	Thunder Bay TGS	*Total Loading*
1	COD	15300	361	–	8450	–	42700	66800
2	Cyanide Total	–	12.2	–	–	–	–	12.2
4	Ammonia plus Ammonium	1740	–	51.5	263	92700	33.6	94800
	Total Kjeldahl nitrogen	1510	1150	–	222	128000	737	132000
	Nitrate+Nitrite	5.59	1510	394	215	6040	18.6	8180
5	DOC	7390	6950	2080	3880	20200	12700	53200
	TOC	7010	169	–	2740	1020	13900	24800
6	Total phosphorus	287	431	2010	264	66.9	76.4	3140
8	Total suspended solids	8320	24900	18900	945	340000	12000	405000
	Volatile suspended solids	–	112	–	–	–	–	112
9	Aluminum	1730	1020	372	73.1	20000	1070	24300
	Boron	135	203	39.4	11.2	27900	173	28500
	Cadmium	1.5	5.1	3.15	4.9	35.3	2.5	52.5
	Chromium	0.595	–	–	–	686	22.3	709
	Copper	5.15	92.5	58.7	37.1	151	25.4	370
	Lithium	–	51.2	–	–	3830	–	3880
	Lead	0.952	–	–	–	–	2.56	3.51
	Molybdenum	15.7	15	–	–	2910	9.43	2950
	Nickel	26.1	132	–	–	15.6	26.2	200
	Strontium	352	351	141	301	33100	493	34700
	Vanadium	–	–	–	–	1600	–	1600
	Zinc	8.02	24.4	20.5	13.9	23	22.3	112
E1	Iron, Unfiltered Total	286	475	212	138	1150	567	2830
10	Antimony	–	–	–	–	87.2	–	87.2
	Arsenic	–	13.2	–	–	–	–	13.2
	Selenium	–	–	–	–	781	–	781
11	Chromium (hexavalent)	6.54	–	–	–	–	–	6.54
12	Mercury	0.119	–	–	–	–	0.364	0.483
14	Phenolics (4AAP)	101	7.52	2.64	9.07	26.4	61.5	208
15	Sulphide	–	–	–	39.8	–	–	39.8
16	Bromodichloromethane	–	1.79	–	–	–	–	1.79
	Chloroform	0.238	6.44	–	0.362	–	16.8	23.8
	Methylene chloride	4.9	–	–	–	–	3.64	8.54
	Trichlorofluoromethane	1.82	–	1.1	–	–	–	2.92
17	Toluene	–	–	–	–	–	5.1	5.1
25	Oil and grease	2510	191	1960	711	16500	1670	23500

Note: Annual loadings are total loadings for the MISA monitoring period (June 1, 1990 to May 31, 1991).

TABLE 16

EPG Sector – Nuclear Stations – Concentrations
Radioactive Liquid Waste Management Tanks (RL)
Units as per RMDL

	Station :		Bruce NGS – A	Bruce NGS – B	Darlington NGS	Pickering NGS A & B	Pickering NGS A & B
	Control Point :		RL 0100	RL 0100	RL 0100	RL 0200	RL 3700
ATG	PARAMETER	RMDL					
1	COD	10 mg/L	39	11.8	82.2	35	–
3	pH		7.61	6.84	7.61	7.4	7.14
4	Ammonia plus Ammonium	0.25 mg/L	0.642	0.275	0.858	0.222	–
	Total Kjeldahl nitrogen	0.5 mg/L	4.06	0.694	3.28	1.46	1
	Nitrate+Nitrite	0.25 mg/L	0.374	–	–	0.264	–
5	DOC	0.5 mg/L	12.2	2.92	8.99	12.7	7.08
	TOC	5 mg/L	26	11.8	15.9	16.5	8.57
6	Total phosphorus	0.1 mg/L	4.08	1.73	1.33	1.29	0.957
7	Conductance	uS/cm	205	71.9	184	219	212
8	Total suspended solids	5 mg/L	7.24	6.94	40.1	10	–
9	Aluminum	30 ug/L	117	88.1	602	88.3	–
	Boron	50 ug/L	79.6	169	–	–	–
	Cadmium	2 ug/L	2.57	–	5.06	2.88	–
	Copper	10 ug/L	89.2	30.9	151	81.7	50.3
	Lithium	50 ug/L	58.1	–	94.7	120	–
	Molybdenum	20 ug/L	–	63.3	–	–	–
	Nickel	20 ug/L	–	–	–	24.2	–
	Strontium	20 ug/L	100	30.6	81	186	–
	Zinc	10 ug/L	161	109	365	160	106
E1	Iron, Unfiltered Total	20 ug/L	1360	925	2140	483	236
12	Mercury	0.1 ug/L	1.31	0.973	–	–	–
14	Phenolics (4AAP)	2 ug/L	5.64	–	10.8	–	–
15	Sulphide	0.02 mg/L	2.68	–	–	–	–
16	1,4–Dichlorobenzene	1.7 ug/L	–	–	0.822	–	–
	Chloroform	0.7 ug/L	8.22	3.57	10	1.84	–
	Methylene chloride	1.3 ug/L	16	283	–	40.9	–
	Tetrachloroethylene	1.1 ug/L	17.4	–	–	–	–
17	m–Xylene and p–Xylene	1.1 ug/L	–	–	3.16	–	–
	o–Xylene	0.5 ug/L	–	–	1.66	–	–
19	Benzylbutylphthalate	0.6 ug/L	–	–	5	–	–
	Bis(2–ethylhexyl) phthalate	2.2 ug/L	14.6	17.1	336	–	–
23	1,2,3–Trichlorobenzene	0.01 ug/L	–	–	0.011	–	–
	1,2,4–Trichlorobenzene	0.01 ug/L	–	–	0.031	–	–
24	Octachlorodibenzo–p–dioxin	0.03 ng/L	–	–	0.324	0.088	–
25	Oil and grease	1 mg/L	1.88	3.49	6.09	11.2	11.4
27	PCBT	0.1 ug/L	0.179	–	–	0.276	0.275
	Flow	m3/day	174	77.6	83.5	429	339
	Days of Discharge		363	348	316	357	11

Note : All flows are batch discharges reported as total volume discharged per day.

TABLE 17

EPG Sector – Nuclear Stations – Loadings (kg/day)
Radioactive Liquid Waste Management Tanks (RL)

	Station :	Bruce	Bruce NGS – B	Darlington NGS	Pickering NGS A & B	Pickering NGS A & B
	Control Point :	RL 0100	RL 0100	RL 0100	RL 0200	RL 3700
ATG	PARAMETER					
1	COD	8.14	0.714	3.09	8.28	–
4	Ammonia plus Ammonium	0.091	0.02	0.069	0.061	–
	Total Kjeldahl nitrogen	0.533	0.05	0.226	0.39	–
	Nitrate+Nitrite	0.06	–	–	0.057	–
5	DOC	2.14	0.211	0.596	5.09	2.41
	TOC	4.15	0.746	1.1	6.72	2.92
6	Total phosphorus	0.674	0.121	0.102	0.536	0.362
8	Total suspended solids	1.23	0.464	3.49	4.04	–
9	Aluminum	0.017	0.006	0.037	0.024	–
	Boron	0.012	0.011	–	–	–
	Cadmium	–	–	–	0.001	–
	Copper	0.014	0.002	0.014	0.032	0.016
	Lithium	0.01	–	0.006	0.028	–
	Molybdenum	–	0.004	–	–	–
	Nickel	–	–	–	0.006	–
	Strontium	0.016	0.002	0.005	0.045	–
	Zinc	0.029	0.008	0.028	0.065	0.037
E1	Iron, Unfiltered Total	0.221	0.068	0.202	0.185	0.074
12	Mercury	–	–	–	–	–
14	Phenolics (4AAP)	0.001	–	–	–	–
15	Sulphide	0.536	–	–	–	–
16	1,4–Dichlorobenzene	–	–	–	–	–
	Chloroform	0.001	–	0.001	0.001	–
	Methylene chloride	0.003	0.018	–	0.009	–
	Tetrachloroethylene	0.003	–	–	–	–
17	m–Xylene and p–Xylene	–	–	–	–	–
	o–Xylene	–	–	–	–	–
19	Benzylbutylphthalate	–	–	–	–	–
	Bis(2–ethylhexyl) phthalate	0.003	0.001	0.012	–	–
23	1,2,3–Trichlorobenzene	–	–	–	–	–
	1,2,4–Trichlorobenzene	–	–	–	–	–
24	Octachlorodibenzo–p–dioxin	–	–	–	–	–
25	Oil and grease	0.325	0.308	0.503	4.53	4.05
27	PCBT	–	–	–	–	–

Note: Loadings less than 0.001 kg/day are not shown.

TABLE 18

EPG Sector – Nuclear Stations and Associated Facilities – Concentrations
Water Treatment Plant (WTP) – Neutralization Sump (NS) Streams
Units as per RMDL

	Station :	Bruce NGS – A	Bruce NGS – B	Darlington NGS	Darlington NGS Constr.	Pickering NGS A & B	BNPD Services
	Control Point :	NS 1400	NS 2000	NS 2200	NS 1100	NS 3100	NS 1400
ATG PARAMETER	RMDL						
1 COD	10 mg/L	16	30.3	27.8	107	–	24
2 Cyanide Total	0.005 mg/L	–	–	0.016	–	–	–
3 pH		2.19	7.73	3.42	4.64	5.65	7.66
4 Ammonia plus Ammonium	0.25 mg/L	–	–	0.288	–	0.314	–
Total Kjeldahl nitrogen	0.5 mg/L	0.589	1.45	1.42	0.416	1.39	0.696
Nitrate+Nitrite	0.25 mg/L	1.67	2.7	2.82	0.337	18.3	2.96
5 DOC	0.5 mg/L	6.33	9.65	9.7	4.39	8.9	7.42
TOC	5 mg/L	–	24.2	10.5	–	8.81	34.3
6 Total phosphorus	0.1 mg/L	0.119	0.068	–	–	–	–
7 Conductance	uS/cm	14800	3730	2070	344	4480	6230
8 Total suspended solids	5 mg/L	–	147	–	6	19.7	4.71
9 Aluminum	30 ug/L	83.5	25100	171	746	1100	86.5
Boron	50 ug/L	68.8	95	182	–	115	118
Cadmium	2 ug/L	2.1	2.03	3.23	3.77	3.9	9.61
Chromium	20 ug/L	–	14.2	–	–	–	–
Copper	10 ug/L	10.8	20.3	25.6	81.7	26.7	20.5
Lithium	50 ug/L	–	–	34.6	–	–	–
Molybdenum	20 ug/L	18.4	24	72.2	–	–	30.8
Nickel	20 ug/L	34.3	–	25.8	–	21.9	33.8
Strontium	20 ug/L	452	653	815	3100	501	1710
Zinc	10 ug/L	8.22	14.1	42.9	39.9	45.6	22.7
E1 Iron, Unfiltered Total	20 ug/L	188	970	427	451	514	451
12 Mercury	0.1 ug/L	0.185	–	0.098	0.49	–	0.105
14 Phenolics (4AAP)	2 ug/L	–	–	25.4	738	–	–
16 Bromodichloromethane	0.8 ug/L	2.08	3.12	2.32	6.24	–	–
Chloroform	0.7 ug/L	2.93	10	11.8	9.33	–	–
Dibromochloromethane	1.1 ug/L	1.04	1.28	–	4.23	–	–
25 Oil and grease	1 mg/L	–	1.29	–	–	2.05	–
Flow	m^3/day	880	563	320	32	972	235

Note: Underlined control points are upstream of direct discharges.

TABLE 19

EPG Sector – Nuclear Stations and Associated Facilities – Loadings (kg/day)
Water Treatment Plant (WTP) – Neutralization Sump (NS) Streams

	Station :	Bruce NGS – A	Bruce NGS – B	Darlington NGS	Darlington NGS Constr.	Pickering NGS A & B	BNPD Services
	Control Point :	NS 1400	NS 2000	NS 2200	NS 1100	NS 3100	NS 1400
ATG	PARAMETER						
1	COD	15.2	15.7	8.89	1.07	–	6.36
2	Cyanide Total	–	–	0.00512	–	–	–
4	Ammonia plus Ammonium	–	–	0.0922	–	0.324	–
	Total Kjeldahl nitrogen	0.476	0.9	0.454	0.011	1.3	0.175
	Nitrate+Nitrite	1.47	1.86	0.902	0.01	32.1	0.685
5	DOC	5.61	6.51	3.1	0.203	8.87	1.73
	TOC	–	15.9	3.36	–	8.87	8.34
6	Total phosphorus	0.108	0.044	–	–	–	–
8	Total suspended solids	–	99.6	–	0.128	14.9	1.09
	Volatile suspended solids	–	19.7	–	–	–	–
9	Aluminum	0.061	14.7	0.0547	0.026	0.949	0.021
	Boron	0.053	0.058	0.0582	–	0.109	0.027
	Cadmium	0.002	0.002	0.00103	–	0.001	0.002
	Chromium	–	0.009	–	–	–	–
	Copper	0.009	0.012	0.00819	0.002	0.027	0.005
	Lithium	–	–	0.0111	–	–	–
	Molybdenum	0.014	0.015	0.0231	–	–	0.006
	Nickel	0.029	–	0.00826	–	0.024	0.009
	Strontium	0.37	0.416	0.261	0.051	0.475	0.368
	Zinc	0.007	0.01	0.0137	0.001	0.043	0.005
E1	Iron, Unfiltered Total	0.165	0.664	0.137	0.008	0.647	0.099
14	Phenolics (4AAP)	–	–	0.00813	0.007	–	–
16	Bromodichloromethane	0.001	0.002	–	–	–	–
	Chloroform	0.002	0.006	0.00378	–	–	–
	Dibromochloromethane	0.001	0.001	–	–	–	–
25	Oil and grease	–	0.804	–	–	1.99	–

Note: Loadings less than .001 kg/day are not shown.
Underlined control points are upstream of direct discharges.

TABLE 20

EPG Sector – Nuclear Stations – Concentrations
Oily Water Separator (OW) Streams – Units as per RMDL

		Station :	Bruce NGS – A	Bruce NGS – B	Darlington NGS	Pickering NGS A & B	Pickering NGS A & B
		Control Point :	OW 1100	OW 1600	OW 1900	OW 2700	OW 3600
ATG	PARAMETER	RMDL					
1	COD	10 mg/L	128	–	24	–	–
2	Cyanide Total	0.005 mg/L	–	–	0.015	–	–
3	pH		7.31	8.69	7.48	7.54	8.73
4	Ammonia plus Ammonium	0.25 mg/L	0.733	–	0.3	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	2.14	–	33.8	–	0.46
5	DOC	0.5 mg/L	23.1	61.3	6.47	2.64	4.86
	TOC	5 mg/L	34.8	–	7.94	–	–
6	Total phosphorus	0.1 mg/L	0.92	–	0.247	–	–
7	Conductance	uS/cm	262	126	256	191	220
8	Total suspended solids	5 mg/L	19.2	26.7	6.15	–	–
9	Aluminum	30 ug/L	1300	–	53.8	60.8	104
	Boron	50 ug/L	284	–	–	–	–
	Cadmium	2 ug/L	19	–	2.6	–	–
	Copper	10 ug/L	92.9	–	16.9	–	–
	Lead	30 ug/L	47.5	–	–	–	–
	Lithium	50 ug/L	98.3	–	–	–	–
	Strontium	20 ug/L	547	75.8	68.9	54	268
	Zinc	10 ug/L	699	105	246	17	94.9
E1	Iron, Unfiltered Total	20 ug/L	3000	241	465	417	1130
10	Arsenic	5 ug/L	36	–	–	–	–
14	Phenolics (4AAP)	2 ug/L	59.3	11.3	7.93	2.07	–
15	Sulphide	0.02 mg/L	12.6	–	–	–	–
19	Bis(2–ethylhexyl) phthalate	2.2 ug/L	49.1	312	–	–	–
	Di–n–butyl phthalate	3.8 ug/L	–	20.9	–	–	–
25	Oil and grease	1 mg/L	5.64	17.3	1.78	3.34	17.2
	Flow	m^3/event	1	0.3	27	0.8	0.9

Note: Underlined control points are upstream of the station RLWM system.
All above Control Points are event discharges monitored once a month.

TABLE 21

EPG Sector
Bruce NGS – A – Direct Discharge Loadings

	Control Points:	BB	NS 1400	RL 0100	Totals Daily	Totals Annual
ATG	PARAMETER	kg/day (4 units)	kg/day	kg/day	kg/day	kg/year
1	COD	–	15.2	8.14	20	7300
4	Ammonia plus Ammonium	1.16	–	0.091	1.19	436
	Total Kjeldahl nitrogen	8.84	0.476	0.533	9.31	3400
	Nitrate+Nitrite	–	1.47	0.06	1.21	442
5	DOC	32.9	5.61	2.14	37.8	13800
	TOC	–	–	4.15	4.13	1510
6	Total phosphorus	–	0.108	0.674	0.755	276
8	Total suspended solids	–	–	1.23	1.22	446
9	Aluminum	0.048	0.061	0.017	0.11	40.3
	Boron	–	0.053	0.012	0.0535	19.5
	Cadmium	–	0.002	–	0.00157	0.572
	Copper	0.044	0.009	0.014	0.0628	22.9
	Lithium	–	–	0.01	0.00995	3.63
	Molybdenum	–	0.014	–	0.011	4
	Nickel	–	0.029	–	0.0227	8.29
	Strontium	–	0.37	0.016	0.306	112
	Zinc	0.072	0.007	0.029	0.103	37.5
E1	Iron, Unfiltered Total	0.092	0.165	0.221	0.437	159
14	Phenolics (4AAP)	0.004	–	0.001	0.0048	1.75
15	Sulphide	–	–	0.536	0.533	195
16	Bromodichloromethane	–	0.001	–	–	0.286
	Chloroform	–	0.002	0.001	0.00256	0.935
	Dibromochloromethane	–	0.001	–	–	0.286
	Methylene chloride	–	–	0.003	0.00298	1.09
	Tetrachloroethylene	–	–	0.003	0.00298	1.09
19	Bis(2–ethylhexyl) phthalate	–	–	0.003	0.00298	1.09
25	Oil and grease	–	–	0.325	0.323	118
	Days of Discharge	347	286	363		

Note: Total annual loadings are calculated based on number of days of discharge.
Boiler Blowdown (BB) loading is average loading of all of the boilers multiplied by No. of Boilers.
Loadings from boiler blowdown are overestimated because not all 4 boilers discharged on each of the 347 discharge days.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings for the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 22

EPG Sector
Bruce NGS – B – Direct Discharge Loadings

	Control Points:	BB	NS 2000	RL 0100	Totals Daily	Totals Annual
		kg/day	kg/day	kg/day	kg/day	kg/year
ATG	PARAMETER	(4 units)				
1	COD	–	15.7	0.714	14.8	5400
4	Ammonia plus Ammonium	8	–	0.02	7.62	2780
	Total Kjeldahl nitrogen	7.8	0.9	0.05	8.27	3020
	Nitrate+Nitrite	–	1.86	–	1.67	610
5	DOC	3.03	6.51	0.211	8.93	3260
	TOC	–	15.9	0.746	15	5470
6	Total phosphorus	–	0.044	0.121	0.155	56.5
8	Total suspended solids	–	99.6	0.464	89.9	32800
	Volatile suspended solids	–	19.7	–	17.7	6460
9	Aluminum	0.424	14.7	0.006	13.6	4970
	Boron	–	0.058	0.011	0.0626	22.9
	Cadmium	–	0.002	–	0.0018	0.656
	Chromium	–	0.009	–	0.00809	2.95
	Copper	0.06	0.012	0.002	0.0697	25.5
	Molybdenum	–	0.015	0.004	0.0173	6.31
	Strontium	–	0.416	0.002	0.376	137
	Zinc	0.052	0.01	0.008	0.066	24.1
E1	Iron, Unfiltered Total	0.16	0.664	0.068	0.814	297
14	Phenolics (4AAP)	0.036	–	–	0.0342	12.5
16	Bromodichloromethane	–	0.002	–	0.0018	0.656
	Chloroform	–	0.006	–	0.00539	1.97
	Dibromochloromethane	–	0.001	–	–	0.328
	Methylene chloride	–	–	0.018	0.0172	6.26
19	Bis(2–ethylhexyl) phthalate	–	–	0.001	–	0.348
25	Oil and grease	–	0.804	0.308	1.02	371
	Days of Discharge	347	328	348		

Note: Total annual loadings are calculated based on number of days of discharge.
Boiler Blowdown (BB) loading is average loading of all of the boilers multiplied by No. of Boilers.
Loadings from boiler blowdown are overestimated because not all 4 boilers discharged on each of the 347 days of discharge.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings for the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 23

Darlington NGS – Direct Discharge Loadings

					Totals	
	Control Point:	BB kg/day (2 units)	NS 2200 kg/day	RL 0100 kg/day	Daily Loadings kg/day	Annual Loadings kg/year
ATG	PARAMETER					
1	COD	–	48.5	3.09	45.1	16400
2	Cyanide Total	–	0.017	–	0.0149	5.42
4	Ammonia plus Ammonium	0.141	0.617	0.069	0.685	250
	Total Kjeldahl nitrogen	0.184	4.05	0.226	3.85	1400
	Nitrate+Nitrite	–	6.47	–	5.65	2060
5	DOC	0.205	24.8	0.596	22.3	8150
	TOC	–	26.6	1.1	24.2	8830
6	Total phosphorus	–	–	0.102	0.0883	32.2
8	Total suspended solids	–	–	3.49	3.02	1100
	Volatile suspended solids	–	–	0.501	0.434	158
9	Aluminum	0.012	0.543	0.037	0.514	188
	Boron	–	0.433	–	0.378	138
	Cadmium	–	0.003	–	0.00262	0.957
	Copper	0.003	0.064	0.014	0.0699	25.5
	Lithium	–	0.073	0.006	0.069	25.2
	Molybdenum	–	0.152	–	0.133	48.5
	Nickel	–	0.066	–	0.0577	21.1
	Strontium	–	1.6	0.005	1.4	512
	Zinc	0.002	0.083	0.028	0.098	35.8
E1	Iron, Unfiltered Total	0.103	1.25	0.202	1.33	486
12	Mercury	–	–	–	–	–
14	Phenolics (4AAP)	0.003	0.007	–	0.00795	2.9
16	1,4–Dichlorobenzene	–	–	–	–	–
	Bromodichloromethane	–	0.005	–	0.00437	1.6
	Chloroform	–	0.04	0.001	0.0358	13.1
17	m–Xylene and p–Xylene	–	–	–	–	–
	o–Xylene	–	–	–	–	–
19	Benzylbutylphthalate	–	–	–	–	–
19	Bis(2–ethylhexyl) phthalate	–	–	0.012	0.0104	3.79
23	1,2,3–Trichlorobenzene	–	–	–	–	–
	1,2,4–Trichlorobenzene	–	–	–	–	–
24	Octachlorodibenzo–p–dioxin	–	–	–	–	–
25	Oil and grease	–	–	0.503	0.435	159
	Days of Discharge	223	319	316		

Note: Total annual loadings are calculated based on the number of days of discharge.
Boiler Blowdown (BB) loading is the average loading of all of the boilers multiplied by the No. of boilers.
Loadings from boiler blowdown are overestimated because not all boilers discharged on each of the 223 days of discharge.
During the monitoing period only 1 reactor operated.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings for the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 24

EPG Sector
Pickering NGS – A & B – Direct Discharge Loadings

	Control Points:	BB	NS 3100	RL 0200	RL 3700	*Totals* Daily	Annual
		kg/day	kg/day	kg/day	kg/day	kg/day	kg/year
ATG	PARAMETER	(8 units)					
1	COD	–	–	8.28	–	8.1	2960
4	Ammonia plus Ammonium	–	0.324	0.061	–	0.366	134
	Total Kjeldahl nitrogen	2.87	1.3	0.39	–	4.46	1630
	Nitrate+Nitrite	–	32.1	0.057	–	30.4	11100
5	DOC	12.2	8.87	5.09	2.41	25.5	9320
	TOC	12.6	8.87	6.72	2.92	27.5	10100
6	Total phosphorus	–	–	0.536	0.362	0.535	195
8	Total suspended solids	–	14.9	4.04	–	18	6580
9	Aluminum	0.048	0.949	0.024	–	0.968	353
	Boron	–	0.109	–	–	0.103	37.6
	Cadmium	–	0.001	0.001	–	0.00192	0.702
	Copper	0.056	0.027	0.032	0.016	0.113	41.2
	Lithium	–	–	0.028	–	0.0274	10
	Nickel	0.064	0.024	0.006	–	0.092	33.6
	Strontium	–	0.475	0.045	–	0.493	180
	Zinc	0.176	0.043	0.065	0.037	0.28	102
E1	Iron, Unfiltered Total	0.064	0.647	0.185	0.074	0.858	313
14	Phenolics (4AAP)	0.016	–	–	–	0.0159	5.79
16	Chloroform	–	–	0.001	–	–	0.357
	Methylene chloride	–	–	0.009	–	0.0088	3.21
25	Oil and grease	2.98	1.99	4.53	4.05	9.39	3430
27	PCBT	–	–	–	–	–	–
	Days of Discharge	362	345	357	11		

Note: Total annual loadings are calculated based on number of days of discharge.
Boiler Blowdown (BB) loading is average loading of all of the boilers multiplied by No. of Boilers.
Loadings from boiler blowdown are overestimated because not all 8 boilers discharged on each of the 362 days of discharge.
Loadings less than 0.001 kg/day are not shown.
Total daily loadings are derived from annual loadings devided by 365 days.

TABLE 25

Annual Loadings from Nuclear Stations (kg/year)

ATG	PARAMETER	Bruce NGS – A	Bruce NGS – B	Darlington NGS	Pickering NGS A&B	*Total Loading*
1	COD	7300	5400	16400	2960	32100
2	Cyanide Total	–	–	5.42	–	5.42
4	Ammonia plus Ammonium	436	2780	250	134	3600
	Total Kjeldahl nitrogen	3400	3020	1400	1630	9450
	Nitrate+Nitrite	442	610	2060	11100	14200
5	DOC	13800	3260	8150	9320	34500
	TOC	1510	5470	8830	10100	25900
6	Total phosphorus	276	56.5	32.2	195	560
8	Total suspended solids	446	32800	1100	6580	40900
	Volatile suspended solids	–	6460	158	–	6620
9	Aluminum	40.3	4970	188	353	5550
	Boron	19.5	22.9	138	37.6	218
	Cadmium	0.572	0.656	0.957	0.702	2.89
	Chromium	–	2.95	–	–	2.95
	Copper	22.9	25.5	25.5	41.2	115
	Lithium	3.63	–	25.2	10	38.8
	Molybdenum	4	6.31	48.5	–	58.8
	Nickel	8.29	–	21.1	33.6	63
	Strontium	112	137	512	180	941
	Zinc	37.5	24.1	35.8	102	199
E1	Iron, Unfiltered Total	159	297	486	313	1260
14	Phenolics (4AAP)	1.75	12.5	2.9	5.79	22.9
15	Sulphide	195	–	–	–	195
16	Bromodichloromethane	0.286	0.656	1.6	–	2.54
	Chloroform	0.935	1.97	13.1	0.357	16.4
	Dibromochloromethane	0.286	0.328	–	–	0.614
	Methylene chloride	1.09	6.26	–	3.21	10.6
	Tetrachloroethylene	1.09	–	–	–	1.09
19	Bis(2–ethylhexyl) phthalate	1.09	0.348	3.79	–	5.23
25	Oil and grease	118	371	159	3430	4080

Note: Annual loadings are total loadings over the MISA monitoring period (June 1, 1990 to May 31, 1991).

TABLE 26

EPG Sector – Nuclear Associated Facilities – Concentrations
Process (PR) Effluent Streams – Units as per RMDL

	Station :		Darlington NGS Constr.	Bruce Heavy Water Plant	Bruce Heavy Water Plant	BNPD Services	BNPD Services	BNPD Services	BNPD Services
	Control Point :		PR 0800	PR 0400 *	PR 0500	PR 0100	PR 0200	PR 0300	PR 0400
ATG	PARAMETER	RMDL							
1	COD	10 mg/L	50.8	17.7	–	13.5	13.1	–	–
2	Cyanide Total	0.005 mg/L	0.027	–	–	–	–	–	–
3	pH		6.94	7.1	8.05	6.69	7.97	7.86	7.81
4	Ammonia plus Ammonium	0.25 mg/L	3.4	–	–	1.94	–	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	6.51	–	–	1.7	1.22	0.602	0.55
	Nitrate+Nitrite	0.25 mg/L	15.7	0.382	0.515	7.29	0.364	0.392	0.473
5	DOC	0.5 mg/L	61.1	2.96	2.08	3.84	5.16	2.35	2.61
	TOC	5 mg/L	126	4.53	–	–	5.28	–	–
6	Total phosphorus	0.1 mg/L	3.69	–	–	0.293	–	–	–
7	Conductance	uS/cm	495	232	253	372	209	243	416
8	Total suspended solids	5 mg/L	15.3	6.13	–	6.73	–	3.05	3.79
9	Aluminum	30 ug/L	186	65.1	49.5	595	121	123	91.3
	Boron	50 ug/L	–	–	–	78.8	–	–	–
	Cadmium	2 ug/L	2.67	–	–	–	–	–	–
	Copper	10 ug/L	34.8	–	–	30.6	10.7	8.37	7.27
	Molybdenum	20 ug/L	–	–	–	–	–	–	–
	Nickel	20 ug/L	–	–	–	–	–	–	–
	Strontium	20 ug/L	211	125	135	588	106	124	164
	Zinc	10 ug/L	83.6	24	14.5	61.3	22.6	10.8	10.3
E1	Iron, Unfiltered Total	20 ug/L	393	610	38.9	92.9	86.3	77.6	87.6
10	Antimony	5 ug/L	3.08	–	–	–	–	–	–
12	Mercury	0.1 ug/L	0.12	–	–	–	–	–	–
14	Phenolics (4AAP)	2 ug/L	13.6	–	1.79	5.05	4.75	5.79	6.63
15	Sulphide	0.02 mg/L	–	††	0.028	–	–	–	–
16	Bromodichloromethane	0.8 ug/L	2.55	–	–	1.17	–	–	–
	Chloroform	0.7 ug/L	12.2	–	–	5.1	–	–	–
	Dibromochloromethane	1.1 ug/L	1.06	–	–	–	–	–	–
17	Toluene	0.5 ug/L	0.332	–	–	–	–	–	–
19	Bis(2–ethylhexyl) phthalate	2.2 ug/L	8.41	–	–	–	–	–	–
25	Oil and grease	1 mg/L	4.1	1.87	1.17	–	–	–	–
E2	Total Residual Oxidants	0.1 mg/L	1.03	–	–	0.772	–	–	–
	Flow	m^3/day	390	704 *	75200	1680	550	5230	9085

Note: * PR 0400 at the Bruce Heavy Water Plant is a control point for monitoring event discharges from the process effluent lagoons.
†† Additional data submitted by Ontario Hydro after MISA monitoring, for the period June 1/90 to March 31/94, indicate an average sulphide concentration of 0.19 mg/L. Flow data for the same period are not available.

TABLE 27

EPG Sector – Nuclear Associated Facilities – Loadings (kg/day) Process (PR) Effluent Streams

Station :	Darlington NGS Constr.	Bruce Heavy Water Plant	Bruce Heavy Water Plant	BNPD Services	BNPD Services	BNPD Services	BNPD Services
Control Point :	PR 0800	PR 0400 *	PR 0500	PR 0100	PR 0200	PR 0300	PR 0400
ATG PARAMETER							
1 COD	18.2	29.5	–	23	5.3	–	–
2 Cyanide Total	0.01	–	–	–	–	–	–
4 Ammonia plus Ammonium	1.47	–	–	3.34	–	–	–
Total Kjeldahl nitrogen	2.78	1.75	–	2.98	0.538	3.23	5.33
Nitrate+Nitrite	6.47	0.712	40.6	12.9	0.185	2	4.65
5 DOC	20.3	2.22	156	6.83	2.42	11.7	23.7
TOC	40.5	2.08	–	–	1.88	–	–
6 Total phosphorus	1.54	–	–	0.515	–	–	–
8 Total suspended solids	5.88	2.8	–	11.4	–	13.8	31.2
9 Aluminum	0.064	0.026	3.99	1.03	0.061	0.544	0.814
Boron	–	–	–	0.142	–	–	–
Cadmium	0.001	–	–	–	–	–	–
Copper	0.014	–	–	0.055	0.006	0.042	0.07
Strontium	0.075	0.146	10.2	1.13	0.061	0.683	1.67
Zinc	0.035	0.025	1.13	0.108	0.013	0.054	0.098
E1 Iron, Unfiltered Total	0.164	0.664	3	0.17	0.049	0.368	0.768
10 Antimony	0.001	–	–	–	–	–	–
12 Mercury	–	–	–	–	–	–	–
14 Phenolics (4AAP)	0.006	–	0.142	0.008	0.002	0.037	0.069
15 Sulphide	–	††	2.36	–	–	–	–
16 Bromodichloromethane	0.001	–	–	0.002	–	–	–
Chloroform	0.005	–	–	0.009	–	–	–
Dibromochloromethane	–	–	–	–	–	–	–
17 Toluene	–	–	–	–	–	–	–
19 Bis(2–ethylhexyl) phthalate	0.003	–	–	–	–	–	–
25 Oil and grease	1.43	1.02	87.6	–	–	–	–
E2 Total Residual Oxidants	0.371	–	–	1.15	–	–	–

Note: * PR 0400 at Bruce Heavy Water Plant based on 12 days of sampling.
Loadings less than 0.001 kg/day are not shown.
†† See note for sulphide concentration on TABLE 26.

TABLE 28

EPG Sector
Darlington NGS (Under Constr.) – Direct Discharge Loadings

	Control Points:	BB	NS 1100	PR 0800	Totals Daily	Totals Annual
		kg/day	kg/day	kg/day	kg/day	kg/year
ATG	PARAMETER	(Note)				
1	COD	4.74	1.07	18.2	23.3	8510
2	Cyanide Total	–	–	0.01	0.00981	3.58
4	Ammonia plus Ammonium	0.002	–	1.47	1.44	527
	Total Kjeldahl nitrogen	0.24	0.011	2.78	2.97	1090
	Nitrate+Nitrite	0.298	0.01	6.47	6.65	2430
5	DOC	1.15	0.203	20.3	21.2	7740
	TOC	1.61	–	40.5	41.3	15100
6	Total phosphorus	0.058	–	1.54	1.57	572
8	Total suspended solids	6.68	0.128	5.88	12.5	4570
	Volatile suspended solids	–	–	5.25	5.15	1880
9	Aluminum	0.062	0.026	0.064	0.142	51.9
	Boron	0.016	–	–	0.016	5.84
	Cadmium	–	–	0.001	–	0.358
	Copper	0.03	0.002	0.014	0.0451	16.5
	Lead	0.004	–	–	0.004	1.46
	Strontium	0.042	0.051	0.075	0.15	54.6
	Zinc	0.004	0.001	0.035	0.039	14.2
E1	Iron, Unfiltered Total	0.184	0.008	0.164	0.35	128
10	Antimony	–	–	0.001	–	0.358
14	Phenolics (4AAP)	0.002	0.007	0.006	0.0126	4.59
16	Bromodichloromethane	0.002	–	0.001	0.00298	1.09
	Chloroform	0.004	–	0.005	0.0089	3.25
	Dibromochloromethane	0.002	–	–	0.002	0.73
19	Bis(2–ethylhexyl) phthalate	–	–	0.003	0.00294	1.07
25	Oil and grease	–	–	1.43	1.4	512
E2	Total Residual Oxidants	–	–	0.371	0.364	133
	Days of Discharge	365	244	358		

Note: Total annual loading are calculated based on number of days of discharge.
Boiler Blowdown (BB) loading is the total loading from both the construction boilers and the TRF boilers.
Loadings from boiler blowdown are overestimated because not all boilers discharged on each of the 365 discharge days.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings over the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 29

EPG Sector
Bruce Heavy Water Plant – Direct discharge loadings

				Totals	
		PR0400 kg/day	PR 0500 kg/day	Daily kg/day	Annual kg/year
ATG	PARAMETER				
1	COD	29.5	–	0.97	354
4	Total Kjeldahl nitrogen	1.75	–	0.0575	21
	Nitrate+Nitrite	0.792	40.6	40.6	14800
5	DOC	2.22	156	156	57000
	TOC	2.08	–	0.0684	25
8	Total suspended solids	2.8	–	0.0921	33.6
9	Aluminum	0.026	3.99	3.99	1460
	Strontium	0.146	10.2	10.2	3720
	Zinc	0.025	1.13	1.13	413
E1	Iron, Unfiltered Total	0.664	3	3.02	1100
14	Phenolics (4AAP)	–	0.142	0.142	51.8
15	Sulphide	–	2.36	2.36	861
25	Oil and grease	1.02	87.6	87.6	32000
	Days of Discharge	12	365		

Note: Total annual loadings are calculated based on the number of days of discharge.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings over the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 30

EPG Sector
BNPD Services – Direct Discharge Loadings

	Control Point:	PR 0100 kg/day	PR 0200 kg/day	PR 0300 kg/day	PR 0400 kg/day	*Totals* Daily kg/day	*Totals* Annual kg/year
ATG	PARAMETER						
1	COD	23	5.3	–	–	28.3	10300
4	Ammonia plus Ammonium	3.34	–	–	–	3.34	1220
	Total Kjeldahl nitrogen	2.98	0.538	3.23	5.33	12	4380
	Nitrate+Nitrite	12.9	0.185	2	4.65	19.7	7180
5	DOC	6.83	2.42	11.7	23.7	44.2	16200
	TOC	–	1.88	–	–	1.87	682
6	Total phosphorus	0.515	–	–	–	0.515	188
8	Total suspended solids	11.4	–	13.8	31.2	55.9	20400
9	Aluminum	1.03	0.061	0.544	0.814	2.44	889
	Boron	0.142	–	–	–	0.142	51.8
	Copper	0.055	0.006	0.042	0.07	0.172	62.7
	Strontium	1.13	0.061	0.683	1.67	3.52	1280
	Zinc	0.108	0.013	0.054	0.098	0.271	99
E1	Iron, Unfiltered Total	0.17	0.049	0.368	0.768	1.34	490
14	Phenolics (4AAP)	0.008	0.002	0.037	0.069	0.115	41.9
16	Bromodichloromethane	0.002	–	–	–	0.002	0.73
	Chloroform	0.009	–	–	–	0.009	3.29
E2	Average Residual Oxidants	1.26	–	–	–	1.26	460
	Maximum Residual Oxidants	2.63	–	–	–	2.63	960
	Minimum Residual Oxidants	0.246	–	–	–	0.246	89.8
	Total Residual Oxidants	1.15	–	–	–	1.15	420
	Days of Discharge	365	363	365	359		

Note: Total annual loadings are calculated based on the number of days of discharge.
Loadings less than 0.001 kg/day are not shown.
Annual loadings are total loadings over the MISA monitoring period.
Total daily loadings are derived from annual loadings divided by 365 days.

TABLE 31

Annual Loadings from Nuclear Associated Facilities (kg/year)

ATG	PARAMETER	Darlington (Const.)	Bruce Heavy Water Plant	BNPD Services	*Total Loading*
1	COD	8510	354	10300	19200
2	Cyanide Total	3.58	–	–	3.58
4	Ammonia plus Ammonium	527	–	1220	1750
	Total Kjeldahl nitrogen	1090	21	4380	5490
	Nitrate+Nitrite	2430	14800	7180	24400
5	DOC	7740	57000	16200	80900
	TOC	15100	25	682	15800
6	Total phosphorus	572	–	188	760
8	Total suspended solids	4570	33.6	20400	25000
	Volatile suspended solids	1880	–	–	1880
9	Aluminum	51.9	1460	889	2400
	Boron	5.84	–	51.8	58
	Cadmium	0.358	–	–	0.358
	Copper	16.5	–	62.7	79
	Lead	1.46	–	–	1.46
	Strontium	54.6	3720	1280	5060
	Zinc	14.2	413	99	526
E1	Iron, Unfiltered Total	128	1100	490	1720
10	Antimony	0.358	–	–	0.358
14	Phenolics (4AAP)	4.59	51.8	41.9	98.3
15	Sulphide		861	–	861
16	Bromodichloromethane	1.09	–	0.73	1.82
	Chloroform	3.25	–	3.29	6.54
	Dibromochloromethane	0.73	–	–	0.73
19	Bis(2–ethylhexyl) phthalate	1.07	–	–	1.07
25	Oil and grease	512	32000	–	32500
E2	Total Residual Oxidants	133	–	420	553

Note: Annual loadings are total loadings over the MISA monitoring period (June 1, 1990 to May 31, 1991).

TABLE 32

Summary of Loadings from the EPG Sector (kg/year)

ATG	PARAMETER	Fossil Stations *Total Loading* (6 Stations)	Nuclear Stations *Total Loading* (4 Stations)	Darlington (Const.)	Bruce Heavy Water Plant	BNPD Services	EPG Sector *Total Loading*
1	COD	66800	32100	8510	354	10300	118000
2	Cyanide Total	12.2	5.42	3.58	–	–	21.2
4	Ammonia plus Ammonium	94800	3600	527	–	1220	100000
	Total Kjeldahl nitrogen	132000	9450	1090	21	4380	147000
	Nitrate+Nitrite	8180	14200	2430	14800	7180	46800
5	DOC	53200	34500	7740	57000	16200	169000
	TOC	24800	25900	15100	25	682	66500
6	Total phosphorus	3140	560	572	–	188	4460
8	Total suspended solids	405000	40900	4570	33.6	20400	471000
	Volatile suspended solids	112	6620	1880	–	–	8610
9	Aluminum	24300	5550	51.9	1460	889	32300
	Boron	28500	218	5.84	–	51.8	28800
	Cadmium	52.5	2.89	0.358	–	–	55.7
	Chromium	709	2.95	–	–	–	712
	Copper	370	115	16.5	–	62.7	564
	Lithium	3880	38.8	–	–	–	3920
	Lead	3.51	–	1.46	–	–	4.97
	Molybdenum	2950	58.8	–	–	–	3010
	Nickel	200	63	–	–	–	263
	Strontium	34700	941	54.6	3720	1280	40700
	Vanadium	1600	–	–	–	–	1600
	Zinc	112	199	14.2	413	99	837
E1	Iron, Unfiltered Total	2830	1260	128	1100	490	5810
10	Antimony	87.2	–	0.358	–	–	87.6
	Arsenic	13.2	–	–	–	–	13.2
	Selenium	781	–	–	–	–	781
11	Chromium (hexavalent)	6.54	–	–	–	–	6.54
12	Mercury	0.483	–	–	–	–	0.483
14	Phenolics (4AAP)	208	22.9	4.59	51.8	41.9	329
15	Sulphide	39.8	195	–	861	–	1100
16	Bromodichloromethane	1.79	2.54	1.09	–	0.73	6.15
	Chloroform	23.8	16.4	3.25	–	3.29	46.7
	Dibromochloromethane	–	0.614	0.73	–	–	1.34
	1,3–Dichlorobenzene	–	–	–	–	–	–
	1,4–Dichlorobenzene	–	–	–	–	–	–
	Methylene chloride	8.54	10.6	–	–	–	19.1
	Tetrachloroethylene	–	1.09	–	–	–	1.09
	Trichlorofluoromethane	2.92	–	–	–	–	2.92
17	Toluene	5.1	–	–	–	–	5.1
19	Benzylbutylphthalate	–	–	–	–	–	–
	Bis(2–ethylhexyl) phthalate	–	5.23	1.07	–	–	6.3
25	Oil and grease	23500	4080	512	32000	–	60100
E2	Total Residual Oxidants	–	–	133	–	420	553

Notes:

Fossil stations include: Atikokan, Lakeview, Lambton, Lennox, Nanticoke and Thunder Bay
Nuclear stations include: Bruce NGS–A, Bruce NGS–B, Darlington NGS and Pickering NGS–A&B
Annual loadings are the total loadings over the MISA monitoring period (June 1, 1990 to May 31, 1991).

TABLE 33

EPG Sector – Boiler Blowdown Streams – Concentrations

(All Streams average concentrations/flows – Units as per RMDL)

ATG	PARAMETER	RMDL	Station :	Atikokan TGS	Lakeview TGS	Lambton TGS	Lennox TGS	Nanticoke TGS	Thunder Bay TGS	Bruce NGS–A	Bruce NGS–B	Darlington NGS	Pickering NGS A & B	Darlington NGS Constr. 0100	Darlington NGS Constr. 0200
1	COD	10 mg/L		–	–	–	–	–	–	–	–	–	–	–	14.8
3	pH			8.09	9.33	8.99	9.07	9.36	8.87	9.35	8.99	8.73	8.67	8.05	10.5
4	Ammonia plus Ammonium	0.25 mg/L		1.3	–	0.124	0.307	0.213	0.286	0.834	1.38	0.786	–	0.243	
	Nitrate+Nitrite	0.25 mg/L		–	–	–	–	–	–	–	–	–	–	–	1.04
	Total Kjeldahl nitrogen	0.5 mg/L		1.01	–	–	–	–	0.607	4.73	1.37	1.1	1.26	–	0.793
5	DOC	0.5 mg/L		1.11	1.48	0.646	1.14	–	2.03	13.7	0.556	0.783	5.22	1.03	5.25
	TOC	5 mg/L		–	–	–	–	–	–	–	–	–	5.32	–	5.94
6	Total phosphorus	0.1 mg/L		0.218	0.338	1.1	0.358	0.284	0.0995	–	–	–	–	–	0.237
7	Conductance	uS/cm		10.2	10.4	11.4	11.9	10.7	8.64	11.6	9.81	80.2	13.1	–	
8	Total suspended solids	5 mg/L		–	–	9.46	–	6.25	–	–	–	–	–	–	13.5
9	Aluminum	30 ug/L		35	69.7	73.2	99.8	67.8	34.6	29.7	64.4	77.4	21.5	–	248
	Boron	50 ug/L		–	–	–	–	–	–	–	–	–	–	–	67.8
	Cadmium	2 ug/L		–	3.04	2.32	3.6	3.24	–	–	–	2.49	–	3.2	2.17
	Copper	10 ug/L		6.37	111	57.5	64.2	574	8.06	25.3	10.1	22.9	28.8	74.7	138
	Lead	30 ug/L		–	–	–	–	–	–	–	–	–	–	–	22.2
	Molybdenum	20 ug/L		23.2	28.4	–	–	29.2	24.3	–	–	–	–	–	–
	Nickel	20 ug/L		–	173	–	–	164	–	–	–	–	23.5	–	–
	Strontium	20 ug/L		–	–	–	–	–	–	–	–	–	–	–	110
	Zinc	10 ug/L		9.87	15.2	14.8	12.4	43.4	15.1	19.5	10.4	19.4	79.2	10.6	24.5
E1	Iron, Unfiltered Total	20 ug/L		240	30.1	95.4	29.3	131	77.2	50.9	31.7	592	26.9	121	1120
12	Mercury	0.1 ug/L		–	–	–	–	–	–	–	–	–	–	–	0.068
14	Phenolics (4AAP)	2 ug/L		28.6	9.13	5.33	10.5	10.6	24.4	1.92	7.67	9.15	6.81	27	18
16	Bromodichloromethane	0.8 ug/L		–	–	–	–	–	–	–	–	–	–	–	4.73
	Chloroform	0.7 ug/L		–	–	–	–	–	–	–	–	–	–	–	6.81
	Dibromochloromethane	1.1 ug/L		–	–	–	–	–	–	–	–	–	–	–	2.7
25	Oil and grease	1 mg/L		1.26	–	1.72	–	–	2.25	–	–	–	1.43	–	–
	No. Units Monitored			1/1	6/8	4/4	4/4	8/8	2/2	3/4	4/4	2/4†	7/8	Note	Note
	Flow	m^3/day		87	319	313	290	47.4	31.5	636	1260	234	294	2.35	151

Note : See section 3.9.3 of this report for a description of effluent monitored at this control point.
Caution – Flows are approximate.
† Darlington NGS (units 1 & 2) was started up during the monitoring period.

TABLE 34

EPG Sector – Building Effluent Streams – Concentrations
Fossil Fuelled Stations – Units as per RMDL

ATG	Parameter	RMDL	Lakeview TGS Sumps	Lakeview TGS 3000	Lambton TGS Units 1&2	Lambton TGS 1900	Lambton TGS Pumphouses	Lambton TGS 2200
03	pH		8.09	8.21	8.09	8.21	8.2	7.19
	Nitrate+Nitrite	0.25 mg/L	0.345	0.378	0.319	0.333	0.315	1.93
	Total Kjeldahl nitrogen	0.5 mg/L	–	–	–	–	–	1.21
05	DOC	0.5 mg/L	2.5	2.56	2.06	2.42	2.41	49.7
	TOC	5 mg/L	–	–	–	–	–	109
06	Total phosphorus	0.1 mg/L	–	–	–	–	0.103	3.25
07	Conductance	uS/cm	323	343	218	279	238	875
08	Total suspended solids	5 mg/L	28.4	15.8	8.4	7.08	849	401
09	Aluminum	30 ug/L	391	242	188	101	6260	2580
	Chromium	20 ug/L	–	–	–	–	24.7	–
	Copper	10 ug/L	19.3	13.5	12.6	18.5	362	54.7
	Zinc	10 ug/L	25.5	24.3	9.25	56.5	156	133
25	Oil and grease	1 mg/L	3.09	2.32	0.9	3.55	38.6	22.4
B1	Iron, Unfiltered Total	20 ug/L	781	441	183	223	12900	5860
	Estimated Total Volume Discharged	m^3/ day	259000	125	30000*	300	31	0.006
	Number of Streams		5	1	1*	1	2	1

Notes:

Concentrations from similar building effluent streams were averaged. Discharge volumes are totals from simlar streams.

Discharge volumes estimated from pump curves and/or level changes in sumps.

Discharge volumes were revised after the MISA monitoring period (reference – Ontario Hydro, A Review of Building Effluent MISA Data from from Ontario Hydro's Sites, October 15, 1992, TOB 07293 T3.

* One building effluent stream (CtrlPt 0900 – Units 1&2) was monitored as representative of the building effluent from Units 3&4.

Flow from Lambton CtrlPt. 2200 is intermittent. Flow value based on a 10 minute discharge duration.

TABLE 34 (cont'd)

EPG Sector – Building Effluent Streams – Concentrations
Fossil Fuelled Stations – Units as per RMDL

ATG	Parameter	RMDL		Lennox TGS 0600	Lennox TGS Sumps	Nanticoke TGS Units 1 to 8	Nanticoke TGS Pumphouses	RL Hearn TGS 0200
03	pH			8.33	8.35	8.09	8.25	7.79
04	Ammonia plus Ammonium	0.25	mg/L	–	–	–	–	0.303
	Nitrate+Nitrite	0.25	mg/L	0.262	0.259	2.32	0.284	0.738
	Total Kjeldahl nitrogen	0.5	mg/L	–	0.49	–	–	1.75
05	DOC	0.5	mg/L	2.94	2.98	2.44	2.33	10.5
	TOC	5	mg/L	–	–	–	–	25.4
06	Total phosphorus	0.1	mg/L	0.129	0.135	–	–	0.782
07	Conductance		uS/cm	306	294	286	287	465
08	Total suspended solids	5	mg/L	7.92	–	16.5	4.83	53.7
09	Aluminum	30	ug/L	110	45.1	256	111	1060
	Copper	10	ug/L	20.7	11.8	16.6	20.1	34.8
	Zinc	10	ug/L	17.2	23.4	–	–	156
23	1,2,4–Trichlorobenzene	0.01	ug/L	–	–	–	–	0.0603
25	Oil and grease	1	mg/L	–	–	5.62	1.46	15.8
E1	Iron, Unfiltered Total	20	ug/L	264	52.3	180	203	2350
	Estimated Total Volume Discharged		m^3/ day	450	59200	330500	1.4	43
	Number of Streams			1	4	8	4	1

Notes:

Concentrations from similar building effluent streams were averaged. Discharge volumes are totals from simlar streams.

Discharge volumes estimated from pump curves and/or level changes in sumps.

Discharge volumes were revised after the MISA monitoring period (reference – Ontario Hydro, A Review of Building Effluent MISA Data from from Ontario Hydro's Sites, October 15, 1992, TOB 07293 T3.

Flow from Nanticoke pumphouses are intermittent. Flow value based on a 3 minute discharge duration for each pumphouse.

Flow from RL Hearn CtrlPt 0200 is intermittent. Flow value based on 12 discharge volume (each 30 – 40 minutes in duration).

TABLE 35

EPG Sector – Building Effluent Streams – Concentrations
Hydraulic Stations – Units as per RMDL

ATG	PARAMETER	RMDL		Aquasabon GS 0100 Sump	Arnprior GS 0100 Sump	Arnprior GS 0200 Sump	Decew Falls GS Sump	Pine Portage GS Sumps	Silver Falls GS Sump	Sir Adam Beck GS Sumps
03	pH			7.38	7.97	7.86	8.23	8.16	7.25	8.08
05	DOC	0.5	mg/L	8.59	4.8	4.81	2.33	5.34	10.8	2.41
	TOC	5	mg/L	8.93			–	5.99	11.6	6.75
07	Conductance		uS/cm	223	126	123	299	158	68.8	319
08	Total suspended solids	5	mg/L	79.9			12.2	30.6	–	18.9
09	Aluminum	30	ug/L	79.2	167	118	311	55.4	35.8	216
	Copper	10	ug/L	44.2	23.5	15.2	15.4	8.08	11.3	32.2
	Lead	30	ug/L	50.3			–	49.2	–	–
	Nickel	20	ug/L	20.2			–	24.6	–	–
	Zinc	10	ug/L	315	16	9.5	–	11.7	–	25.1
14	Phenolics (4AAP)	2	ug/L	23.9	1.88		2.28	10.2	9.42	3.4
25	Oil and grease	1	mg/L	1.8			–	8.3	4.81	2.89
E1	Iron, Unfiltered Total	20	ug/L	1930	239	141	417	188	109	695
	Estimated Total Volume Discharged		m^3/ day	115*	108	2243	345	144	54	10 to 300**
	Number Streams			1	1	1	1	2	1	8

Note:

Concentrations from similar building effluent streams were averaged. Discharge volumes are totals for similar streams.

All streams discharge intermittently. Discharge volumes estimated from pump curves and/or level changes in sumps.

Discharge volumes were revised after the MISA monitoring period (reference – Ontario Hydro, A Review of Building Effluent MISA Data from Ontario Hydro's Sites, October 15, 1992, TOB 07293 T3.

* Intermittent discharge. Daily flow should not be extrapolated to an annual rate.

** Can be up to 5200 m^3/ day – draft tube leakage.

TABLE 36

EPG Sector – Building Effluent Streams – Concentrations
Nuclear Stations and Associated Facilities – Units as per RMDL

ATG	PARAMETER	RMDL	Bruce NGS – A Reheater Drains	Bruce NGS – B Inactive Drains	Bruce NGS – B Reheater Drains	Darlington NGS 0200	Darlington NGS 0300	Darlington NGS 0400	Darlington NGS Pumphouses
03	pH		8	8.37	8.4	8.22	8.8	8.56	8.53
04	Ammonia plus Ammonium	0.25 mg/L	0.654	0.825	0.664	–	–	0.611	–
	Nitrate+Nitrite	0.25 mg/L	0.355	0.354	0.73	0.27	–	–	0.716
	Total Kjeldahl nitrogen	0.5 mg/L	3.78	0.986	0.942	0.585	–	1.15	0.887
05	DOC	0.5 mg/L	10.8	1.74	4.22	2.12	–	2.05	4.05
06	Total phosphorus	0.1 mg/L	0.267	–	0.408	–	–	–	–
07	Conductance	uS/cm	85.8	167	138	284	817	227	390
08	Total suspended solids	5 mg/L	–	–	–	18.3	–	11	14.3
09	Aluminum	30 ug/L	126	67.3	96.6	221	–	113	234
	Cadmium	2 ug/L	–	–	2.25	2.37	–	2.84	4.37
	Chromium	20 ug/L	–	–	–	–	–	–	18.6
	Copper	10 ug/L	118	18.6	28.7	37.3	–	21.4	105
	Molybdenum	20 ug/L	–	–	27.8	–	–	–	–
	Zinc	10 ug/L	58.8	14.5	40.6	47.8	–	14.1	903
14	Phenolics (4AAP)	2 ug/L	2.58	–	16.9	10.4	–	5.67	3.53
25	Oil and grease	1 mg/L	1.72	–	1.9	0.835	–	–	4.84
E1	Iron, Unfiltered Total	20 ug/L	503	114	341	1120	–	447	1970
	Estimated Total Volume Discharged	m^3/ day	70.8	432	6.81	14.9	0.0118	2.1	0.31
	Number of Streams in Average		4	4	4	1	1	1	2

Notes:

Concentrations from similar building effluent streams were averaged. Discharge volumes are totals from similar streams.

All streams discharge intermittently. Discharge volumes estimated from pump curves and/or level changes in sumps.

Discharge volumes were revised after the MISA monitoring period (reference – Ontario Hydro, A Review of Building Effluent MISA Data from Ontario Hydro's Sites, October 15, 1992, TOB 07293 T3.

TABLE 36 (cont'd)

EPG Sector – Building Effluent Streams – Concentrations
Nuclear Stations and Associated Facilities – Units as per RMDL

ATG	PARAMETER	RMDL	Darlington NGS Sumps	Darlington NGS 1600	Pickering NGS – A & B Bldg. Effluents	Bruce Heavy Water Plant 0100
03	pH		8.47	8.28	8.26	6.82
04	Ammonia plus Ammonium	0.25 mg/L	2.66	–	1.09	–
	Nitrate+Nitrite	0.25 mg/L	0.296	0.385	0.328	–
	Total Kjeldahl nitrogen	0.5 mg/L	3.16	0.967	0.903	–
05	DOC	0.5 mg/L	4.35	2.74	2.9	2.98
	TOC	5 mg/L	11.7	–	–	–
06	Total phosphorus	0.1 mg/L	0.551	–	–	–
07	Conductance	uS/cm	354	279	343	196
08	Total suspended solids	5 mg/L	31.8	17.2	63	31.6
09	Aluminum	30 ug/L	324	121	166	–
	Cadmium	2 ug/L	4.12	2.88	2.55	–
	Copper	10 ug/L	163	22.8	20.9	–
	Molybdenum	20 ug/L	26	–	–	–
	Nickel	20 ug/L	–	–	21.3	–
	Zinc	10 ug/L	459	73.6	18.2	59.8
12	Mercury	0.1 ug/L	0.105	–	–	–
14	Phenolics (4AAP)	2 ug/L	104	4.64	–	–
25	Oil and grease	1 mg/L	4.33	–	2.76	–
E1	Iron, Unfiltered Total	20 ug/L	3050	376	529	474
	Estimated Total Volume Discharged	m^3/ day	20.4	5.6	6222	5050
	Number of Streams in Average		10	1	8	1

Notes:

Concentrations from similar building effluent streams were averaged. Discharge volumes are totals from similar streams.

Darlington and Pickering streams discharge intermittently. Bruce Heavy Water Plant discharges continuously.

Discharge volumes were revised after the MISA monitoring period (reference – Ontario Hydro, A Review of Building Effluent MISA Data from Ontario Hydro's Sites, October 15, 1992, TOB 07293 T3.

TABLE 37

EPG Sector –
Intake (IN), Transformer Cooling Water and Outfall Once Through (OT) Cooling Water Streams – Concentrations
Units as per RMDL
(Fossil Fuelled Stations) – Page 1 of 2

	Station :	Atikokan TGS	Atikokan TGS	Lakeview TGS	Lakeview TGS	Lambton TGS	Lambton TGS	Lambton TGS	Lambton TGS	Lennox TGS	Lennox TGS	Lennox TGS	Lennox TGS
	ControlPoint :	IN 1000	OT 0100	IN 2900	OT 0100	IN 0100	OT 0200	OT 1300 *	OT 1800 *	IN 2000	OT 0200	OT 1500 *	OT 1600 *
ATG	PARAMETER	RMDL											
1	COD	10 mg/L	14.3	–	16	–	–	–	–	–	13.7	–	–	–
3	pH		7.67	7.61	8.08	8.14	8.26	8.31	8.24	8.28	8.25	8.32	8.31	8.29
4	Ammonia plus Ammonium	0.25 mg/L	0.868	–	–	–	–	–	–	–	0.221	–	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	0.814	–	–	–	–	–	–	–	0.448	–	–	–
	Nitrate+Nitrite	0.25 mg/L	–	–	0.395	–	0.359	–	–	–	0.285	–	–	–
5	DOC	0.5 mg/L	5.77	5.65	3.81	2.55	2.45	2.2	2.1	2.19	3.75	3.53	2.95	2.9
	TOC	5 mg/L	5.35	–	4.68	–	–	–	–	–	4.22	–	–	–
6	Total phosphorus	0.1 mg/L	0.189	0.202	–	–	0.151	–	–	–	0.216	0.152	0.122	0.127
7	Conductance	uS/cm	106	111	334	332	204	205	208	222	307	310	305	307
8	Total suspended solids	5 mg/L	–	–	15.7	18.8	10.3	15.5	8.91	6.8	–	–	–	–
9	Aluminum	30 ug/L	33.3	76.7	259	333	207	111	184	80.1	48	41.6	48.3	50.2
	Cadmium	2 ug/L	–	–	2.14	2	2.31	–	–	–	4.02	3.48	2.82	2.93
	Chromium	20 ug/L	–	–	–	–	–	–	–	–	–	–	–	–
	Copper	10 ug/L	–	–	11.3	13.5	10.5	18	10.9	12.4	24	13.3	12.1	12.3
	Nickel	20 ug/L	–	–	–	–	–	–	–	–	–	–	–	–
	Strontium	20 ug/L	41.4	48.7	184	185	105	103	103	105	183	181	187	183
	Zinc	10 ug/L	7.85	19.3	12.4	14	8.79	9.5	13.3	10.1	6.8	–	8.75	12.1
E1	Iron, Unfiltered Total	20 ug/L	86.1	45.5	419	541	289	138	286	128	–	42.3	77	66.3
12	Mercury	0.1 ug/L	0.12	–	–	–	0.082	–	–	–	–	–	–	–
14	Phenolics (4AAP)	2 ug/L	46.9	32.2	7.37	–	4.76	–	–	–	8.87	4.93	4.47	4.89
16	Chloroform	0.7 ug/L	–	–	–	–	–	–	–	–	–	–	–	–
	Methylene chloride	1.3 ug/L	–	–	–	–	–	–	–	–	–	–	–	–
	Trichlorofluoromethane	1 ug/L	–	–	–	–	1.32	–	–	–	–	–	–	–
20	Phenol	2.4 ug/L	–	–	–	–	–	–	–	–	4.84	–	–	–
25	Oil and grease	1 mg/L	1.73	1.63	1.27	3.16	2.51	1.23	1.11	–	–	–	–	–
27	PCBT	0.1 ug/L	2.72	–	–	–	–	–	–	–	–	–	–	–
	Flow	m^3/day		476000		4210000		2320000	2730	2360		1870000	8250	7750

Note :

Outfalls (OT) monitored monthly.

Intakes (IN) monitored voluntarily by Ontario Hydro (Bordered).

* Streams at Lambton and Lennox with a " * " are transformer cooling water streams.

TABLE 37 (cont'd.)

EPG Sector – Intake (IN) and Outfall Once Through (OT) Cooling Water Streams – Concentrations

Units as per RMDL

(Fossil Fuelled Stations) – Page 2 of 2

ATG	PARAMETER	Control Point: RMDL	Station: Nanticoke TGS IN 3000	Nanticoke TGS OT 0200	RL Hearn TGS IN 0600	RL Hearn TGS OT 0300	Thunder Bay TGS IN 1700	Thunder Bay TGS OT 0100
1	COD	10 mg/L	–	–	–	–	38.6	–
3	pH		8.18	8.29	8.07	8.01	7.44	7.47
4	Ammonia plus Ammonium	0.25 mg/L	–	–	–	–	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	–	–	0.473	–	0.716	–
	Nitrate+Nitrite	0.25 mg/L	0.288	–	0.497	–	–	–
5	DOC	0.5 mg/L	2.92	3.04	2.47	2.33	14.8	14.2
	TOC	5 mg/L	–	–	–	–	15.4	14.8
6	Total phosphorus	0.1 mg/L	–	–	–	–	–	–
7	Conductance	uS/cm	286	290	426	421	145	139
8	Total suspended solids	5 mg/L	10.6	6.17	–	–	18.4	12
9	Aluminum	30 ug/L	216	144	83.5	103	719	379
	Cadmium	2 ug/L	2.17	–	–	–	1.92	1.83
	Chromium	20 ug/L	–	–	–	–	21.8	–
	Copper	10 ug/L	9.23	15.3	9.18	18.5	13.4	6.83
	Nickel	20 ug/L	–	–	–	–	23.4	–
	Strontium	20 ug/L	172	179	187	185	24.5	24.8
	Zinc	10 ug/L	10.5	–	7.91	11.8	24.9	17.6
E1	Iron, Unfiltered Total	20 ug/L	274	177	119	131	1180	550
12	Mercury	0.1 ug/L	–	–	–	–	0.127	–
14	Phenolics (4AAP)	2 ug/L	12.9	2.77	3.26	4.26	46.7	56.5
16	Chloroform	0.7 ug/L	–	–	–	–	15.5	23.3
	Methylene chloride	1.3 ug/L	–	–	–	–	7.66	–
	Trichlorofluoromethane	1 ug/L	–	–	–	–	–	–
20	Phenol	2.4 ug/L	–	–	–	–	–	–
25	Oil and grease	1 mg/L	1.8	1.29	–	–	2.05	1.9
27	PCBT	0.1 ug/L	–	–	–	–	–	–
	Flow	m^3/day		5330000		387000		939000

Note:

Outfalls (OT) monitored monthly.

Intakes (IN) monitored voluntarily by Ontario Hydro (Bordered).

TABLE 38

EPG Sector – Intake (IN) and Outfall Once Through (OT) Cooling Water Streams – Concentrations

Units as per RMDL

(Nuclear Stations & Nuclear Associated Facilities) – Page 1 of 3

		Station :	Bruce NGS – A	Bruce NGS – A	Bruce NGS – B	Bruce NGS – B	Darlington NGS	Darlington NGS	Darlington NGS Constr.	Darlington NGS Constr.
		ControlPoint :	IN 1500	OT 1000	IN 2100	OT 1400	IN 2400	OT 1800	IN 1200	OT 0300*
ATG	PARAMETER	RMDL								
3	pH		7.74	8.15	8.13	8.24	8.25	8.33	8.01	8.11
	Total Kjeldahl nitrogen	0.5 mg/L	–	–	–	–	0.506	0.506	–	–
	Nitrate+Nitrite	0.25 mg/L	0.393	0.358	0.392	0.358	0.404	0.269	0.291	0.36
5	DOC	0.5 mg/L	2.31	3	1.84	2.02	2.44	2.52	2.17	1.69
	TOC	5 mg/L	–	–	–	–	–	–	–	–
6	Total phosphorus	0.1 mg/L	0.122	–	–	–	–	–	–	–
7	Conductance	uS/cm	216	207	222	210	290	317	314	320
8	Total suspended solids	5 mg/L	–	3.65	–	–	–	–	–	–
9	Aluminum	30 ug/L	71.7	67.2	72.1	76	107	86.8	149	143
	Cadmium	2 ug/L	–	–	–	–	–	–	3.05	–
	Copper	10 ug/L	8.44	11	67.4	–	28.9	10.8	13.9	23
	Strontium	20 ug/L	105	–	117	–	174	–	178	–
	Zinc	10 ug/L	–	8	12.6	21	13.8	8.46	6.81	8
E1	Iron, Unfiltered Total	20 ug/L	79.5	65.8	52.2	71.9	140	73.3	24.4	326
14	Phenolics (4AAP)	2 ug/L	–	–	4.51	–	11.1	–	6.53	–
15	Sulphide	0.02 mg/L	1.69	–	–	–	–	–	–	–
16	Bromodichloromethane	0.8 ug/L	–	–	–	–	–	–	7.7	–
	Chloroform	0.7 ug/L	–	–	–	–	5.85	–	8.5	–
	Dibromochloromethane	1.1 ug/L	–	–	–	–	0.793	–	5.34	–
25	Oil and grease	1 mg/L	–	–	0.848	–	–	–	1.49	–
	Flow	m^3/day		10300000		14600000		4510000	1950	215

Note:

Outfalls (OT) monitored monthly.

Intakes (IN) monitored voluntarily by Ontario Hydro (Bordered).

* : not main outfalls, but other direct discharges.

TABLE 38 (cont'd.)

EPG Sector – Intake (IN) and Outfall Once Through (OT) Cooling Water Streams – Concentrations

Units as per RMDL

(Nuclear Stations & Nuclear Associated Facilities) – Page 2 of 3

		Station :	Pickering NGS	Pickering NGS	Pickering NGS	Pickering NGS	Pickering NGS	Pickering NGS	Pickering NGS	Pickering NGS	Pickering NGS	Pickering NGS	Pickering NGS
			A & B	A–U3	A–U4	A–U1&2	A & B	A	B	A	A & B	B	B
		ControlPoint :	IN 3400	OT 1900	OT 2000	OT 2100	OT 2200*	OT 2300*	OT 2400*	OT 2500*	OT 2600*	OT 3200	OT 3300*
ATG	PARAMETER	RMDL											
3	pH		8.21	8.24	8.21	8.28	8.11	8.27	8.23	8.26	8.31	8.28	8.42
	Total Kjeldahl nitrogen	0.5 mg/L	0.756	0.592	0.773	0.581	0.671	0.69	0.602	0.641	0.727	0.756	0.707
	Nitrate+Nitrite	0.25 mg/L	6.65	0.414	0.37	0.422	0.383	0.431	0.382	0.369	0.402	0.404	0.36
5	DOC	0.5 mg/L	4.39	3.69	3.78	3.35	3.54	3.61	3.18	3.65	4.47	4.24	4
	TOC	5 mg/L	4.45	–	–	–	–	–	–	–	4.74	–	–
6	Total phosphorus	0.1 mg/L	0.263	–	–	–	–	–	–	–	–	–	–
7	Conductance	uS/cm	327	321	299	326	329	322	322	296	331	330	325
8	Total suspended solids	5 mg/L	14.3	7.74	7.16	6.52	–	11	7.54	5.77	22	22.9	6.25
9	Aluminum	30 ug/L	177	152	148	165	197	174	97.4	94.2	272	223	96.1
	Cadmium	2 ug/L	2.35	–	–	–	–	–	–	–	–	–	–
	Copper	10 ug/L	14.4	13.9	16.3	18.1	10.9	14.8	567	16	25.6	16.8	12
	Strontium	20 ug/L	179	–	–	–	–	–	–	–	–	–	–
	Zinc	10 ug/L	15.6	17.2	18.1	28.3	10.9	186	22.6	766	22.4	16.8	69.8
E1	Iron, Unfiltered Total	20 ug/L	242	147	153	173	193	291	445	215	462	326	123
14	Phenolics (4AAP)	2 ug/L	4.49	–	–	–	–	–	–	–	–	–	–
15	Sulphide	0.02 mg/L	–	–	–	–	–	–	–	–	–	–	–
16	Bromodichloromethane	0.8 ug/L	–	–	–	–	–	–	–	–	–	–	–
	Chloroform	0.7 ug/L	–	–	–	–	–	–	–	–	–	–	–
	Dibromochloromethane	1.1 ug/L	–	–	–	–	–	–	–	–	–	–	–
25	Oil and grease	1 mg/L	2.2	–	1.14	2.19	2.46	4.72	1.62	1.9	1.3	2.34	3.26
	Flow	m^3/day		N/A	2420000	4320000	9160	700000	1100000	1090	70300	9390000	7100

Note :

Outfalls (OT) monitored monthly.

Intakes (IN) monitored voluntarily by Ontario Hydro (Bordered).

* : not main outfalls, but other direct discharges.

TABLE 38 (cont'd.)

EPG Sector – Intake (IN) and Outfall Once Through (OT) Cooling Water Streams – Concentrations

Units as per RMDL

(Nuclear Stations & Nuclear Associated Facilities) – page 3 of 3

		Station :	Bruce Heavy Water Plant	Bruce Heavy Water Plant	BNPD Services
		ControlPoint :	IN 0900	OT 0200	OT 1500*
ATG	PARAMETER	RMDL			
3	pH		8.11	7.9	8.25
	Total Kjeldahl nitrogen	0.5 mg/L	–	–	–
	Nitrate+Nitrite	0.25 mg/L	0.581	0.394	–
5	DOC	0.5 mg/L	1.99	2.54	3.3
	TOC	5 mg/L	–	–	–
6	Total phosphorus	0.1 mg/L	–	–	–
7	Conductance	uS/cm	212	219	417
8	Total suspended solids	5 mg/L	–	–	–
9	Aluminum	30 ug/L	78	120	92.8
	Cadmium	2 ug/L	–	–	–
	Copper	10 ug/L	–	–	9.67
	Strontium	20 ug/L	123	–	175
	Zinc	10 ug/L	23.1	24.8	10.1
E1	Iron, Unfiltered Total	20 ug/L	74.8	–	65.7
14	Phenolics (4AAP)	2 ug/L	–	2.29	–
15	Sulphide	0.02 mg/L	–	–	–
16	Bromodichloromethane	0.8 ug/L	–	–	–
	Chloroform	0.7 ug/L	–	–	–
	Dibromochloromethane	1.1 ug/L	–	–	–
25	Oil and grease	1 mg/L	–	–	–
	Flow	m^3/day		1510000	11600

Note :

Outfalls (OT) monitored monthly.

Intakes (IN) monitored voluntarily by Ontario Hydro (Bordered).

* Shared with Douglas Point WMF (AECL).

TABLE 39

EPG Sector – Intake (IN) and Transformer Once Through (OT) Cooling Water Streams – Concentrations

Units as per RMDL
(Hydraulic Stations)

	Station :	Aquasabon GS	Arnprior GS	Decew Falls NF 23 GS	Decew Falls NF 23 GS	Decew Falls NF 23 GS	Pine Portage GS	Silver Falls GS	Sir Adam Beck 2 GS	Sir Adam Beck 2 GS	Sir Adam Beck 2 GS
	ControlPoint :	IN 0400	IN 0500	IN 0700	OT 0200	OT 0300	IN 0500	IN 0400	IN 1400	OT 0900	OT 1000
ATG	PARAMETER	RMDL									
3	pH		7.43	7.86	8.23	8.22	8.22	7.8	7.36	8.17	8.1	8.11
5	DOC	0.5 mg/L	7.85	4.92	2.11	2.17	2.16	5.28	10.8	2.13	2.22	2.29
	TOC	5 mg/L	8.19	–	–	–	5.9	5.5	11.4	–	–	8.11
7	Conductance	uS/cm	129	115	296	298	298	148	61.6	282	284	285
8	Total suspended solids	5 mg/L	12.6	–	9.48	11.4	10.7	–	–	12.4	30.2	74.3
9	Aluminum	30 ug/L	202	127	300	–	–	36.7	34.2	522	–	–
	Cadmium	2 ug/L	1.92	2.4	2.53	–	–	–	–	2.25	–	–
	Copper	10 ug/L	–	10.1	16	–	–	–	–	107	–	–
	Nickel	20 ug/L	–	–	–	–	–	22.5	–	–	–	–
	Zinc	10 ug/L	472	–	41.6	–	–	30.8	–	57.8	–	–
E1	Iron, Unfiltered Total	20 ug/L	1840	104	383	–	–	22.8	95.8	927	–	–
14	Phenolics (4AAP)	2 ug/L	25.3	–	1.84	–	–	27.9	14.6	2.62	–	–
25	Oil and grease	1 mg/L	1.22	–	–	–	–	1.74	2.07	–	1.09	–
	Flow	m^3/day	3880000	24300000	15800000	540	540	29000000	3450000	129000000	1140	1140

Note :

Intakes (IN) monitored voluntarily by Ontario Hydro (Bordered).

OT streams are transformer cooling water streams.

TABLE 40

EPG Sector – Concentrations
Emergency Overflows (EO) (Fossil Stations)
Waste Disposal (WD) Streams (Nuclear Support Facilities)
Units as per RMDL

	Station :		Atikokan TGS	Atikokan TGS	Lakeview TGS	Lakeview TGS	Lakeview TGS	Lambton TGS	Nanticoke TGS	Thunder Bay TGS	Darlington Constructuion Site	BNPD Services
	Control Point :		EO 0500	EO 1300	EO 2100	EO 2200	EO 3900	EO 0300	EO 2400	EO 1000	WD 1300	WD 1300
ATG	PARAMETER	RMDL										
3	pH		8.48	7.72	8.8	5.47	8.4	7.98	6.08	7.42	8.13	8.24
4	Ammonia plus Ammonium	0.25 mg/L	1.18	1.1	–	0.7	4.17	–	–	–	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	0.998	1.68	–	2.42	–	–	0.832	0.71	973	0.945
	Nitrate+Nitrite	0.25 mg/L	–	–	0.47	3.51	3.23	0.467	0.922	–	–	0.512
5	DOC	0.5 mg/L	7.09	9.21	3.05	4.17	2.98	2.03	6.85	14.8	7.04	4.82
	TOC	5 mg/L	7.43	–	–	62.4	–	–	–	16.4	7.95	6.95
6	Total phosphorus	0.1 mg/L	0.775	0.551	–	0.207	–	–	–	0.32	–	–
7	Conductance	uS/cm	263	97.2	622	2200	863	377	2070	275	611	440
8	Total suspended solids	5 mg/L	299	304	17	197	334	36.8	157	31.6	–	114
9	Aluminum	30 ug/L	–	–	–	–	–	–	–	–	209	–
	Copper	10 ug/L	14.9	24.5	–	65	–	–	29.8	–	–	–
	Zinc	10 ug/L	16.2	18.8	–	467	13.5	1680	18.5	–	22.3	191
E1	Iron, Unfiltered Total	20 ug/L	6350	4320	290	42500	965	758	1750	–	253	636
14	Phenolics (4AAP)	2 ug/L	–	–	–	–	–	–	–	–	3.71	–
25	Oil and grease	1 mg/L	2.00	3.56	–	16.1	–	1.2	–	–	–	2.66
	Average Flow	m^3/event	2310	168	115	275	149	121	64	1880	111	1271
	Average Discharge Duration	h	16.6	24	0.6	1.4	0.46	0.14	57.3	11	24	14.1
	No. of Events Monitored		31	8	1	5	2	4	4	3	3	10

Note : Underlined Control Point at Nanticoke discharges to building effluent and then to the outfall channel.
Concentrations / Flows are averages of events monitored.

TABLE 41

EPG Sector – Equipment Cleaning Effluent Stream – Concentrations
Units as per RMDL

			Boiler Cleaning Waste			Air Preheater Wash					
	Station:		Lakeview TGS	Lambton TGS	Nanticoke TGS	Lakeview TGS	Lambton TGS	Nanticoke TGS	Nanticoke TGS	Nanticoke TGS	Nanticoke TGS
	Control Point:		EC 1900	EC 1500	2206	2000	1400	2310	2320	2330	2340
ATG	PARAMETER	RMDL									
03	Hydrogen ion (pH)		8.1	7.75	7.42	7.7	53.1	4.9	3.81	3.86	5.09
04	Ammonia plus Ammonium	0.25 mg/L	0.62	16	597	1.69	1.62	22.6	0.297	6.28	4.68
	Nitrate+Nitrite	0.25 mg/L	2.17	–	–	0.63	0.325	0.57	–	0.44	0.904
	Total Kjeldahl nitrogen	0.5 mg/L	1.2	23.7	63.4	1.47	1.71	–	28	8.47	5.02
05	DOC	0.5 mg/L	2.2	7.7	322	1.9	3.2	3.7	2.7	1.9	1.92
	TOC	5 mg/L	–	8.45	1420	–	–	–	–	–	–
06	Total phosphorus	0.1 mg/L	0.11	–	4.72	–	–	1.65	4.3	5.67	1.9
07	Specific conductance	5 uS/cm	2210	3330	40500	986	2530	1950	4770	2210	1300
08	Total suspended solids	5 mg/L	11	26	7.88	12.5	11	8160	1150	1100	1480
09	Aluminum	30 ug/L	771	126	879	256	236	200000	152000	97600	39100
	Beryllium	10 ug/L	–	–	16.8	–	–	37	217	15.8	–
	Boron	50 ug/L	675	67700	–	563	665	2900	2320	1590	776
	Cadmium	2 ug/L	–	–	49.5	–	3.4	20.8	334	17.3	5.48
	Chromium	20 ug/L	–	–	–	–	–	1060	1640	578	407
	Cobalt	20 ug/L	–	–	–	–	–	160	220	117	64.8
	Copper	10 ug/L	–	15	129000	–	–	977	2660	686	399
	Lead	30 ug/L	–	–	83.5	–	–	122	450	132	66.4
	Lithium	50 ug/L	107	2620	–	290	160	346	783	152	129
	Molybdenum	20 ug/L	–	294	123	92	–	126	200	60	–
	Nickel	20 ug/L	40	–	76100	–	–	770	3740	705	436
	Silver	30 ug/L	–	–	–	–	–	–	59	–	–
	Strontium	20 ug/L	1560	4920	33.4	558	475	4080	3610	3110	1580
	Thallium	30 ug/L	–	–	–	–	–	510	5650	–	298
	Vanadium	30 ug/L	–	–	–	–	–	2220	2120	1310	684
	Zinc	10 ug/L	36	170	10200	–	–	485	1940	766	387
E1	Iron, Unfiltered Total	20 ug/L	1480	524	5540	1580	246	472000	300000	326000	275000
14	Phenolics (4AAP)	2 ug/L	–	–	89.1	–	–	–	3	1.67	–
25	Oil and grease	1 mg/L	4.2	–	305	–	–	–	–	–	–
	Average Volume Discharged	m3	700	7253	423	4195	2316	41326	14300	9770	25600
	Average Discharge Duration	h	5	42.9	5.75	15	33	18.5	25	26.1	18.3
	Number of Discharges Monitored		1	2	4	2	2	2	1	3	5

Note: Underlined control points are upstream of other monitoring points.

TABLE 41 (cont'd)

EPG Sector – Equipment Cleaning Effluent Stream – Concentrations
Units as per RMDL

			External Boiler Wash			Boiler Layup		
	Station:		Nanticoke TGS	Nanticoke TGS	Nanticoke TGS	Bruce–B 16	Bruce–B 16	Pickering 19
	Control Point:		2220	2240	2270	2300	2600	3800
ATG	PARAMETER	RMDL						
03	Hydrogen ion (pH)		7.7	8.44	9.17	9.78	9.85	–
04	Ammonia plus Ammonium	0.25 mg/L	25.2	–	3.9	5.86	10.8	–
	Nitrate+Nitrite	0.25 mg/L	23	0.25	7	–	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	31	–	6.8	6.32	13.3	108
05	DOC	0.5 mg/L	116	3.5	56.9	0.675	–	20
	TOC	5 mg/L	133	–	70.1	–	–	20
06	Total phosphorus	0.1 mg/L	1.9	–	0.83	–	–	–
	Specific conductance	5 uS/cm	4590	322	1800	36.2	28.4	60.3
08	Total suspended solids	5 mg/L	19600	17	3650	–	–	–
09	Aluminum	30 ug/L	208000	253	30300	–	–	–
	Beryllium	10 ug/L	27.5	–	–	–	–	–
	Boron	50 ug/L	13200	95	3590	–	–	–
	Cadmium	2 ug/L	283	4.6	52.4	–	–	–
	Chromium	20 ug/L	490	–	214	–	–	–
	Cobalt	20 ug/L	146	–	46	–	–	–
	Copper	10 ug/L	2850	14	504	66.3	82.5	620
	Lead	30 ug/L	310	–	80	–	–	–
	Lithium	50 ug/L	1310	–	928	–	–	–
	Molybdenum	20 ug/L	152	–	50	–	–	–
	Nickel	20 ug/L	310	–	360	–	–	239
	Strontium	20 ug/L	4070	265	4140	–	–	–
	Thallium	30 ug/L	115	–	–	–	–	–
	Vanadium	30 ug/L	848	–	120	–	–	–
	Zinc	10 ug/L	85000	49	12100	–	–	68.4
E1	Iron, Unfiltered Total	20 ug/L	173000	112	29600	184	112	718
14	Phenolics (4AAP)	2 ug/L	17	2	13	–	–	27.7
25	Oil and grease	1 mg/L	180	–	74	1.1	1.1	28.3
	Average Volume Discharged	m3	77.3	700	5496	148	140	4080
	Average Discharge Duration	h	7.25	65.5	11.5	1.36	1.92	2.9
	Number of Discharges Monitored		1	1	1	4	2	5

Note: Underlined control points are upstream of the ash trasnport water treatment system.

TABLE 41 (cont'd)

EPG Sector – Equipment Cleaning Effluent – Concentrations
Units as per RMDL

ATG	PARAMETER	RMDL	Darlington NGS Heating Steam Condensate EC 2700	Darlington Construction Pipe Treating Facility Rinse Tanks Tank 2 EC 0600	Darlington Construction Pipe Treating Facility Rinse Tanks Tank 4 EC 0700	Darlington Construction Waste Lagoons East EC 0400	Darlington Construction Waste Lagoons West EC 0500	Bruce Heavy Water Plant Carbonated Equipment/ Drain EC 0300	Bruce Heavy Water Plant Surface Water Treatment Facility EC 0600	Bruce Nuclear Power Development Services Chemical Waste Pond EC 0600
01	COD	10 mg/L	10	–	–	–	–	–	–	–
03	Hydrogen ion (pH)		8.32	8.26	7.31	8.9	9	10.4	8.13	7.75
04	Ammonia plus Ammonium	0.25 mg/L	0.725	–	–	–	–	–	–	–
	Nitrate+Nitrite	0.25 mg/L	–	0.259	0.22	–	–	–	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	1.33	–	–	–	–	–	–	–
05	DOC	0.5 mg/L	1.85	4	5.32	3.21	1.16	25.7	4.55	6.58
	TOC	5 mg/L	–	–	5.76	–	–	–	–	–
06	Total phosphorus	0.1 mg/L	–	1.21	7.08	–	–	0.351	–	–
	Specific conductance	5 uS/cm	7.85	381	312	279	214	11200	662	883
08	Total suspended solids	5 mg/L	–	–	–	–	–	13.2	5.75	–
09	Aluminum	30 ug/L	33	357	142	74	117	–	–	–
	Copper	10 ug/L	59.2	50.7	134	–	14	132	9.58	36.5
	Zinc	10 ug/L	102	17.2	11.1	–	10	134	129	–
E1	Iron, Unfiltered Total	20 ug/L	398	387	986	334	338	2260	243	600
14	Phenolics (4AAP)	2 ug/L	5.13	16.8	5.8	–	–	–	–	–
15	Sulphide	0.02 mg/L	–	–	–	–	–	0.7	–	–
16	Chloroform	0.7 ug/L	–	18.2	4.81	–	–	–	–	–
23	1,2,4,5–Tetrachlorobenzene	0.01 ug/L	0.013	–	–	–	–	–	–	–
	Average Volume Discharged	m3	112	20.6	20.6	875	875	15.4	1880	590
	Average Discharge Duration	h	24	1.18	1.16	14.5	14.5	3.31	4.61	12
	Number of Discharges Monitored		31	12	12	2**	2**	6	12	2

Notes: ** Only flow was measured for both discharges from each of the Darlinton Construction waste lagoons.
Analytical data were reported for only one discharge from each lagoon.

Notes for Underlined Control Points: Pipe rinse tanks at Darlington Construction Site are upstream of the sewage treatment plant (PR 0800).
Carbonated equipment/equipment drains at BHWP are upstream of the surface water treatment facility.

TABLE 42

EPG Sector – Storm Water Streams – Concentrations – Units as per RMDL

(Fossil Fuelled Stations) – Page 1 of 2

ATG	PARAMETER	RMDL	Atikokan TGS SW 0700	J.C. Keith TGS SW 0100	J.C. Keith TGS SW 0200	Lakeview TGS SW 2500	Lakeview TGS SW 2600	Lambton TGS SW 1600	Lennox TGS SW 2100	Lennox TGS SW 2200
3	pH		7.91	7.47	7.9	7.53	7.81	7.99	8.1	7.78
4	Ammonia plus Ammonium	0.25 mg/L	1.2	–	–	0.347	–	–	0.288	0.334
	Total Kjeldahl nitrogen	0.5 mg/L	–	0.703	–	0.999	0.704	–	0.49	0.488
	Nitrate+Nitrite	0.25 mg/L	–	–	1.58	0.69	0.842	1.05	0.868	0.647
5	DOC	0.5 mg/L	6	5.74	2.68	5.02	2.87	3.17	2.33	3.44
	TOC	5 mg/L	–	17.9	8.5	30.8	6.03	–	–	–
6	Total phosphorus	0.1 mg/L	0.104	0.093	–	0.478	0.235	0.256	0.192	0.175
7	Conductance	uS/cm	124	1130	872	656	483	441	532	560
8	Total suspended solids	5 mg/L	–	90.7	17.3	349	94.3	207	91.7	62.2
9	Aluminum	30 ug/L	222	643	163	6490	1980	3130	883	836
	Chromium	20 ug/L	–	–	–	16.2	–	–	–	–
	Copper	10 ug/L	–	13.6	17.3	104	25.8	22	19.2	14.2
	Molybdenum	20 ug/L	–	68	–	–	–	–	–	–
	Zinc	10 ug/L	–	32.2	65.2	244	210	117	186	68.7
E1	Iron, Unfiltered Total	20 ug/L	125	1220	413	5190	3090	5770	1380	1200
10	Antimony	5 ug/L	–	–	–	4.46	–	–	–	–
	Arsenic	5 ug/L	–	11.9	–	26.5	4.54	–	–	–
12	Mercury	0.1 ug/L	–	0.072	–	0.091	–	–	–	–
14	Phenolics (4AAP)	2 ug/L	99.1	5	7.86	–	–	–	10.6	5.24
16	Trichlorofluoromethane	1 ug/L	–	–	0.77	–	–	–	–	–
25	Oil and grease	1 mg/L	1.86	1.17	3.16	4.73	1.46	3.09	–	–
27	PCBT	0.1 ug/L	–	–	–	0.365	–	0.115	–	0.174
	Est. Average Volume	m^3/average event	3550	81.6	135	240	1600	1630	526	115
	Number of Storm Events Monitored		4	8	12	12	12	12	12	12

TABLE 42 (cont'd.)

EPG Sector – Storm Water Streams – Concentrations – Units as per RMDL

(Fossil Fuelled Stations) – Page 2 of 2

ATG	PARAMETER	RMDL	Nanticoke TGS SW 2500	Nanticoke TGS SW 2600	Nanticoke TGS SW 2700	Nanticoke TGS SW 2750	RL Hearn TGS SW 0100	Thd. Bay TGS SW 1200	Thd. Bay TGS SW 1300
3	pH		8.14	8.23	8.1	8.44	7.4	7.77	7.64
4	Ammonia plus Ammonium	0.25 mg/L	–	–	–	–	1.11	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	0.785	–	0.463	0.656	3.89	0.842	0.825
	Nitrate+Nitrite	0.25 mg/L	0.466	0.502	1.42	0.644	0.875	0.253	0.262
5	DOC	0.5 mg/L	3.48	2.83	3.03	7.92	5.66	6.43	6.53
	TOC	5 mg/L	11.7	–	4.4	8.79	16.1	6.82	6.76
6	Total phosphorus	0.1 mg/L	0.165	–	0.285	0.35	1.23	–	–
7	Conductance	uS/cm	247	253	390	363	481	183	490
8	Total suspended solids	5 mg/L	199	61.6	501	255	83.2	6.23	–
9	Aluminum	30 ug/L	2120	843	10700	11600	1880	427	128
	Chromium	20 ug/L	–	–	–	20	–	–	–
	Copper	10 ug/L	29.6	56.2	37.2	24.9	27.2	14.2	18.3
	Lead	30 ug/L	–	–	–	–	27.7	–	–
	Molybdenum	20 ug/L	–	–	–	27.8	–	–	–
	Zinc	10 ug/L	84.8	158	159	70.3	93.1	111	45.4
E1	Iron, Unfiltered Total	20 ug/L	2760	1160	15000	12800	3660	777	652
10	Arsenic	5 ug/L	–	–	–	19.1	–	–	–
12	Mercury	0.1 ug/L	–	–	–	–	0.135	–	–
14	Phenolics (4AAP)	2 ug/L	–	–	–	1.33	4.61	24.1	38.9
24	Octachlorodibenzofuran	0.03 ng/L	–	–	–	–	0.071	–	–
	Octachlorodibenzo–p–dioxin	0.03 ng/L	–	–	–	–	0.527	–	–
	Total H7CDD	0.03 ng/L	–	–	–	–	0.116	–	–
	Total H7CDF	0.03 ng/L	–	–	–	–	0.047	–	–
25	Oil and grease	1 mg/L	3.73	1.49	2.13	3.57	3.21	3.25	1.43
27	PCBT	0.1 ug/L	0.391	–	–	–	0.27	–	–
	Est. Average Volume	m^3/average event	222	85.3	1080	109	30.6	3.02	116
	Number of Storm Events Monitored		10	10	10	10	12	12	12

TABLE 43

EPG Sector – Storm Water Streams – Concentrations – Units as per RMDL
(Hydraulic Stations)

ATG	PARAMETER	RMDL	Aquasabon GS SW 0200	Arnprior GS SW 0300	Decew Falls NF 23 GS SW 0400	Decew Falls NF 23 GS SW 0500	Pine Portage GS SW 0300	Silver Falls GS SW 0200	Sir Adam Beck 2 GS SW 1100	Sir Adam Beck 2 GS SW 1200
3	pH		7.66	7.4	8.08	7.29	8.54	7.78	7.6	7.57
4	Ammonia plus Ammonium	0.25 mg/L	–	–	–	–	0.39	–	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	0.842	0.759	–	1.77	1.13	0.85	0.732	2.7
	Nitrate+Nitrite	0.25 mg/L	–	–	0.934	0.465	0.594	0.288	1.65	0.573
5	DOC	0.5 mg/L	8.32	35.7	5.86	41.9	7.66	7.32	8.75	18.4
	TOC	5 mg/L	8.75	–	–	62.3	7.88	7.3	–	27
6	Total phosphorus	0.1 mg/L	0.22	0.203	–	0.115	0.108	0.24	–	0.184
7	Conductance	uS/cm	475	233	733	521	277	109	484	228
8	Total suspended solids	5 mg/L	–	7.11	–	10.6	–	33.4	14.4	54
9	Aluminum	30 ug/L	3340	82	344	126	159	1750	145	667
	Cadmium	2 ug/L	3	2.27	2.33	8.39	–	–	2.98	6.27
	Copper	10 ug/L	32.1	29.8	13	56.5	20	27.3	349	95.8
	Zinc	10 ug/L	48.3	399	229	504	10	82.5	360	1960
10	Arsenic	5 ug/L	61	–	80.4	11.3	5.56	–	310	6.88
14	Phenolics (4AAP)	2 ug/L	40.5	36.6	10.4	25.9	26.9	28.2	15.2	5.73
25	Oil and grease	1 mg/L	1.29	52.5	8.08	178	4.76	1.49	22	46
27	PCBT	0.1 ug/L	–	–	–	0.664	–	–	–	0.399
	Est. Average Volume	m^3/average event	269	0.788	130	5.88	14.7	6.56	136	0.299
	Number of Storm Events Monitored		9	9	15	15	10	8	12	12

TABLE 44

EPG Sector – Storm Water Streams – Concentrations – Units as per RMDL
(Nuclear Stations)

ATG	PARAMETER	RMDL	Bruce NGS – A SW 1300	Bruce NGS – B SW 1700	Bruce NGS – B SW 1800	Bruce NGS – B SW 1900	Darlington NGS SW 2000	Darlington NGS SW 2100	Pickering NGS A & B SW 2800	Pickering NGS A & B SW 2900	Pickering NGS A & B SW 3000
3	pH		7.81	8.06	7.83	7.79	8.46	8.13	8.02	8.11	8.37
4	Nitrate+Nitrite	0.25 mg/L	1.33	0.348	0.505	0.786	1.32	0.69	4.47	0.926	0.394
5	DOC	0.5 mg/L	4.98	2.04	2.73	3.48	8.98	6.54	4.66	4.31	3.33
	TOC	5 mg/L	–	–	–	4.51	10.8	8.61	–	–	–
6	Total phosphorus	0.1 mg/L	0.127	–	–	–	0.332	–	0.126	–	–
7	Conductance	uS/cm	247	225	168	435	195	564	2090	1030	362
8	Total suspended solids	5 mg/L	7.09	17.2	16.8	22.9	117	80.8	24.9	20	20.5
9	Aluminum	30 ug/L	147	527	274	476	2130	1540	190	437	208
	Copper	10 ug/L	18.1	11.5	12.6	15.1	23.4	12.4	11.3	9.67	23.1
	Molybdenum	20 ug/L	–	–	–	–	–	–	–	28.3	–
	Zinc	10 ug/L	192	62.3	122	192	673	89.2	415	95	20.2
E1	Iron, Unfiltered Total	20 ug/L	346	618	442	758	2440	1750	348	746	310
14	Phenolics (4AAP)	2 ug/L	3.32	–	–	–	13.3	7.42	3.96	–	–
25	Oil and grease	1 mg/L	3.53	3.41	5.84	1.66	6.79	2.01	4	–	5.05
27	PCBT	0.1 ug/L	0.098	–	–	–	–	–	–	–	–
	Est. Average Volume	m^3/average event	1210	566	546	1520	102	1630	192	599	24.2
	Number of Storm Events Monitored		10	13	11	12	12	11	12	12	12

TABLE 45

EPG Sector – Storm Water Streams – Concentrations – Units as per RMDL

(Nuclear Associated Facilities)

ATG	PARAMETER	RMDL	Bruce Heavy Water Plant SW 0700	Bruce Heavy Water Plant SW 0800	Darlington NGS Constr. SW 0900	Darlington NGS Constr. SW 1000	BNPD Services SW 0700	BNPD Services SW 0800	BNPD Services SW 0900	BNPD Services SW 1000	BNPD Services SW 1100	BNPD Services SW 1200
3	pH		8.43	8.19	8.04	8.08	8.09	8.1	8.01	8.05	7.95	7.89
4	Ammonia plus Ammonium	0.25 mg/L	1.91	0.57	–	–	0.166	0.204	–	–	–	–
	Total Kjeldahl nitrogen	0.5 mg/L	–	–	1.88	1.94	1.31	2.78	0.547	0.749	1.04	0.658
	Nitrate+Nitrite	0.25 mg/L	–	–	1.13	1.6	0.872	1.86	0.569	0.4	0.552	0.354
5	DOC	0.5 mg/L	5.56	4.1	5.66	5.41	5.1	4.31	4.78	5.62	5.76	8.3
	TOC	5 mg/L	–	–	9.37	9.49	–	4.93	–	6.61	–	9.58
6	Total phosphorus	0.1 mg/L	–	0.122	0.121	0.218	–	0.092	108	–	–	–
7	Conductance	uS/cm	385	380	514	375	663	793	728	580	497	643
8	Total suspended solids	5 mg/L	124	98.7	164	307	30.7	37.4	23.3	21.7	5.95	13.7
9	Aluminum	30 ug/L	–	–	1400	3820	330	138	352	503	110	319
	Copper	10 ug/L	15.4	9.07	32.2	123	9.92	12.5	8.42	12.9	9.92	8.58
	Zinc	10 ug/L	117	112	762	1250	51.9	62.9	32.7	45.4	29	12.2
E1	Iron, Unfiltered Total	20 ug/L	2630	1900	2190	6370	151	604	419	484	140	266
14	Phenolics (4AAP)	2 ug/L	–	–	7.38	6.87	6.82	–	–	–	2.29	2.59
25	Oil and grease	1 mg/L	1.16	1.39	11.2	1.68	1.46	–	1.68	1.17	1.35	1.27
	Est. Average Volume	m^3/average event	225	1191	263	638	1450	2420	7780	3090	4070	1430
	Number of Storm Events Monitored		15	12	12	12	10	10	12	10	10	10

TABLE 46

EPG Sector – Detection of Mercury RMDL = 0.1 ug/L

Units as per RMDL

Site	Control Point	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
01 – Atikokan TGS	AT 0200	13	51	0.12	0.5	1
	CP 0400	2	7	0.171	0.5	
	IN 1000	12	50	0.12	0.7	1
	NS 0800	48	50	2.38	28	1
	OW 0600	1	4	0.1	0.1	
	SW 0700	1	5	0.1	0.1	
02 – J.C. Keith TGS	SW 0100	4	10	0.072	0.15	1
	SW 0200	3	12	0.182	1.45	
03 – Lakeview TGS	AT 0200	6	52	0.0692	0.75	
	CP 1700	4	12	0.0975	0.27	1
	CP 1800	4	16	0.0781	0.19	
	IN 2900	7	52	0.0542	0.46	
	NS 2700	23	52	0.131	0.6	1
	SW 2500	4	12	0.0908	0.2	1
	SW 2600	3	12	0.0717	0.13	
04 – Lambton TGS	AT 0800	7	50	0.0524	0.22	
	BB 0500	1	1	0.11	0.11	
	CP 1000	3	11	0.0609	0.17	
	CP 1100	4	12	0.123	0.65	1
	IN 0100	10	46	0.0839	1.06	1
	NS 1200	17	48	0.0898	0.51	1
	SW 1600	2	11	0.0773	0.43	
05 – Lennox TGS	IN 2000	5	50	0.0472	0.16	
	NS 2300	35	46	0.198	0.65	1
	SW 2100	2	11	0.104	0.58	
	SW 2200	2	11	0.119	0.61	

Note: This table presents a summary of mercury data for all streams where mercury was detected at least once at a level above or equal to the RMDL.
Those streams where mercury is classified as priority 1 are indicated by a '1' under the Priority column.

TABLE 46 (cont'd)

EPG Sector – Detection of Mercury RMDL = 0.1 ug/L

Units as per RMDL

Site	Control Point	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
06 – Nanticoke TGS	AT 0100	5	51	0.0663	0.44	
	BB 1700	1	1	0.16	0.16	
	CP 2000	4	10	0.154	0.48	1
	CP 2100	2	10	0.087	0.36	
	IN 3000	5	51	0.061	0.36	
	NS 2800	9	47	0.0775	0.48	1
	SW 2500	1	10	0.07	0.3	
	SW 2600	3	10	0.12	0.52	
	SW 2700	2	9	0.0944	0.47	
	SW 2750	2	9	0.18	0.7	
07 – RL Hearn TGS	SW 0100	5	12	0.135	0.42	1
08 – Thunder Bay TGS	AT 0200	18	52	0.281	4.8	1
	CP 0700	5	12	0.167	0.5	1
	IN 1700	11	52	0.127	1.1	1
	NS 1500	42	45	1.99	44.7	1
	OW 1100	1	4	0.1	0.1	
	SW 1200	4	15	0.147	0.6	1
	SW 1300	2	15	0.227	2	
15 – Bruce NGS – A	BE 0200	1	12	0.0467	0.13	
	BE 0500	2	12	0.226	1.74	
	NS 1400	3	4	0.185	0.42	1
	OW 1100	2	4	0.118	0.22	
	RL 0100	4	4	1.31	3.71	1

Note: This table presents a summary of mercury data for all streams where mercury was detected at least once at a level above or equal to the RMDL.
Those streams where mercury is classified as priority 1 are indicated by a '1' under the Priority column.

TABLE 46 (cont'd)

EPG Sector – Detection of Mercury RMDL = 0.1 ug/L

Units as per RMDL

Site	Control Point	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
16 – Bruce NGS – B	BB 1000	1	2	0.1	0.16	
	BB 1100	1	1	0.11	0.11	
	BE 0200	1	12	0.172	1.59	
	BE 0300	1	12	0.0525	0.19	
	BE 0400	1	11	0.0518	0.16	
	BE 0500	3	12	0.0658	0.23	
	BE 0600	1	12	0.0875	0.57	
	BE 0700	2	12	0.0467	0.11	
	BE 0800	3	10	0.079	0.27	
	BE 0900	2	12	0.0775	0.39	
	IN 2100	1	4	0.1	0.28	
	NS 2000	2	4	0.1	0.16	
	RL 0100	3	3	0.973	1.56	1
17 – Darlington NGS	BE 0200	2	12	0.0567	0.12	
	BE 0400	1	11	0.0464	0.12	
	BE 0800	1	8	0.0538	0.1	
	BE 0900	2	8	0.11	0.4	
	BE 1000	2	11	0.0682	0.27	
	BE 1100	1	11	0.0555	0.13	
	BE 1200	3	11	0.0609	0.15	
	BE 1300	1	10	0.056	0.16	
	BE 1400	4	12	0.105	0.46	1
	BE 1500	2	12	0.055	0.13	
	BE 1600	1	12	0.0475	0.16	
	BE 2500	1	9	0.0522	0.11	
	NS 2200	4	5	0.098	0.13	1
	RL 0100	1	5	0.21	0.91	

Note: This table presents a summary of mercury data for all streams where mercury was detected at least once at a level above or equal to the RMDL.
Those streams where mercury is classified as priority 1 are indicated by a '1' under the Priority column.

TABLE 46 (cont'd)

EPG Sector – Detection of Mercury RMDL = 0.1 ug/L
Units as per RMDL

Site	Control Point	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
18 – Darlington NGS (Under Constr.)	BB 0100	1	14	0.0414	0.1	
	BB 0200	11	51	0.0682	0.52	1
	EC 0700	1	12	0.0458	0.17	
	IN 1200	4	52	0.0494	0.17	
	NS 1100	33	42	0.49	1.46	1
	PR 0800	16	52	0.12	2.2	1
19 – Pickering NGS – A & B	BE 0100	2	12	0.0608	0.33	
	BE 0300	2	12	0.075	0.46	
	BE 0400	2	11	0.0791	0.34	
	BE 0500	1	12	0.0883	0.74	
	BE 0700	2	12	0.11	0.63	
	BE 0900	2	12	0.0592	0.16	
	NS 3100	1	4	0.123	0.36	
	RL 0200	1	4	0.0525	0.12	
21 – BNPD Services	NS 1400	3	4	0.105	0.15	1
	PR 0100	4	51	0.0608	0.198	

Note: This table presents a summary of mercury data for all streams where mercury was detected at least once at a level above or equal to the RMDL.
Those streams where mercury is classified as priority 1 are indicated by a '1' under the Priority column.

TABLE 47

EPG Sector – Detection of Polychlorinated biphenyls (PCBs) RMDL = 0.1 ug/L

Units as per RMDL

Site	Control Point	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
01 – Atikokan TGS	AT 0200	2	4	0.11	0.32	
	IN 1000	5	12	2.72	24.4	1
	NS 0800	1	4	0.055	0.1	
	OW 0600	2	4	0.28	1	
02 – J.C. Keith TGS ***	SW 0200	2	12	0.0698	0.21	
03 – Lakeview TGS ***	IN 2900	1	13	0.0466	0.11	
	OW 2400	3	4	0.085	0.12	1
	SW 2500	4	11	0.198	0.86	1
	SW 2600	3	12	0.107	0.59	
04 – Lambton TGS ***	SW 1600	5	11	0.115	0.33	1
05 – Lennox TGS ***	SW 2100	2	12	0.0593	0.11	
	SW 2200	4	12	0.174	1.2	1
06 – Nanticoke TGS ***	IN 3000	1	12	0.0462	0.2	
	SW 2500	6	10	0.391	1.09	1
	SW 2600	3	10	0.0912	0.25	
	SW 2700	2	10	0.16	1.02	
	SW 2750	1	8	0.055	0.12	
07 – RL Hearn TGS ***	SW 0100	11	12	0.27	0.63	1
08 – Thunder Bay TGS	AT 0200	1	4	0.09	0.33	
	BB 0600	1	1	0.1	0.1	
	IN 1700	2	12	0.0517	0.33	
	SW 1200	2	15	0.0453	0.26	
	SW 1300	1	15	0.0193	0.15	
09 – Aquasabon GS ***	SW 0200	1	12	0.0808	0.6	
11 – Decew Falls NF 23 GS	SW 0400	1	14	0.0446	0.1	
	SW 0500	5	14	0.254	1.5	1
13 – Silver Falls GS	SW 0200	1	8	0.065	0.14	

Note: This table presents a summary of PCB data for all streams where PCBs were detected at least once at a level above or equal to the RMDL.
Those streams where PCBs are classified as priority 1 are indicated by a '1' under the Priority column.

*** PCB data collected at this site is considered to be overestimated due to overrecovery of PCBs from travelling spiked blank QC samples.

TABLE 47 (cont'd)

EPG Sector – Detection of Polychlorinated biphenyls (PCBs) RMDL = 0.1 ug/L

Units as per RMDL

Site	Control Point	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
14 – Sir Adam Beck 2 GS ***	SW 1100	1	12	0.0832	0.58	
	SW 1200	4	12	0.4	2.4	1
15 – Bruce NGS – A ***	OW 1100	1	4	0.055	0.115	
	RL 0100	28	51	0.17	1.95	1
	SW 1300	5	10	0.0982	0.34	1
16 – Bruce NGS – B ***	IN 2100	1	51	0.0378	0.12	
	RL 0100	1	54	0.0412	0.11	
	SW 1900	1	10	0.0448	0.18	
17 – Darlington NGS ***	IN 2400	1	49	0.0375	0.49	
	SW 2100	1	12	0.0353	0.115	
18 – Darlington NGS (Under Constr.) ***	PR 0800	2	50	0.0512	0.63	
19 – Pickering NGS – A & B ***	IN 3400	2	51	0.0395	0.12	
	OW 2700	1	4	0.0565	0.1	
	OW 3600	1	3	0.138	0.33	
	RL 0200	40	50	0.276	1.58	1
	RL 3700	2	2	0.275	0.43	1
	SW 2800	1	12	0.0465	0.13	
20 – Bruce Heavy Water Plant ***	PR 0400	1	14	0.0686	0.37	
	SW 0700	1	15	0.048	0.123	
21 – BNPD Services ***	PR 0300	1	12	0.0582	0.28	

Note: This table presents a summary of PCB data for all streams where PCBs were detected at least once at a level above or equal to the RMDL.
Those streams where PCBs are classified as priority 1 are indicated by a '1' under the Priority column.

*** PCB data collected at this site is considered to be overestimated due to overrecovery of PCBs from travelling spiked blank QC samples.

TABLE 48

EPG Sector – Detection of Polychlorinateddibenzo–p–dioxins and dibenzofurans

Units as per RMDL

Site	Parameter	Control Point	RMDL	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
01 – Atikokan TGS	Total PCDD	AT 0200	0.020 ng/L	1	4	0.0223	0.032	
	Total PCDD	IN 1000	0.020 ng/L	1	4	0.0215	0.029	
	Total PCDD	NS 0800	0.020 ng/L	1	4	0.021	0.027	
	Total PCDD	OW 0600	0.020 ng/L	1	4	0.0203	0.024	
	Total PCDF	NS 0800	0.015 ng/L	1	4	0.018	0.033	
	Total H6CDD	NS 0800	0.030 ng/L	1	4	0.044	0.11	
	Total H6CDF	NS 0800	0.020 ng/L	1	4	0.0388	0.11	
	Total H7CDD	NS 0800	0.030 ng/L	1	4	0.0428	0.12	
	Total H7CDF	NS 0800	0.030 ng/L	1	4	0.0775	0.25	
	Octachlorodibenzo–p–dioxin	NS 0800	0.030 ng/L	1	4	0.08	0.26	
	Octachlorodibenzofuran	NS 0800	0.030 ng/L	1	4	0.089	0.29	
03 – Lakeview TGS	Octachlorodibenzo–p–dioxin	OW 2300	0.030 ng/L	1	3	0.0347	0.044	
07 – RL Hearn TGS	Total TCDF	SW 0100	0.015 ng/L	3	11	0.0234	0.067	
	Total PCDF	SW 0100	0.015 ng/L	3	11	0.0357	0.13	
	Total H6CDD	SW 0100	0.030 ng/L	2	11	0.0309	0.094	
	Total H6CDF	SW 0100	0.020 ng/L	3	11	0.0339	0.1	
	Total H7CDD	SW 0100	0.030 ng/L	10	11	0.116	0.39	1
	Total H7CDF	SW 0100	0.030 ng/L	5	11	0.0469	0.12	1
	Octachlorodibenzo–p–dioxin	IN 0600	0.030 ng/L	1	11	0.0287	0.08	
	Octachlorodibenzo–p–dioxin	SW 0100	0.030 ng/L	8	9	0.249	0.65	1
	Octachlorodibenzofuran	SW 0100	0.030 ng/L	4	11	0.0708	0.45	1
08 – Thunder Bay TGS	Octachlorodibenzo–p–dioxin	IN 1700	0.030 ng/L	1	4	22.3	89	
15 – Bruce NGS – A	Total H7CDD	OW 1100	0.030 ng/L	1	3	0.0377	0.071	
	Octachlorodibenzo–p–dioxin	OW 1100	0.030 ng/L	1	3	0.121	0.33	

Note: This table presents a summary of dioxin and furan data for all streams where a dioxin or furan compound was detected at least once at a level above or equal to the RMDL. Those streams where a dioxin or furan compound is classified as priority 1 are indicated by a '1' under the Priority column.

TABLE 48 (cont'd)

EPG Sector – Detection of Polychlorinateddibenzo–p–dioxins and dibenzofurans

Units as per RMDL

Site	Parameter	Control Point	RMDL	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
16 – Bruce NGS – B	Total H7CDD	OW 1600	0.030 ng/L	1	4	0.0373	0.086	
	Total H7CDD	RL 0100	0.030 ng/L	1	3	0.0607	0.14	
	Total H7CDF	RL 0100	0.030 ng/L	1	3	0.0427	0.078	
	Octachlorodibenzo–p–dioxin	OW 1600	0.030 ng/L	1	4	0.064	0.204	
	Octachlorodibenzo–p–dioxin	RL 0100	0.030 ng/L	2	3	0.104	0.22	1
17 – Darlington NGS	2,3,7,8 TCDD	OW 1900	0.020 ng/L	1	4	0.0203	0.026	
	Total TCDD	OW 1900	0.020 ng/L	1	4	0.0203	0.026	
	Total TCDF	RL 0100	0.015 ng/L	2	5	0.0252	0.042	
	Total PCDD	OW 1900	0.020 ng/L	1	4	0.0208	0.025	
	Total PCDF	RL 0100	0.015 ng/L	2	5	0.025	0.042	
	Total H6CDF	OW 1900	0.020 ng/L	1	4	0.0198	0.021	
	Total H7CDD	IN 2400	0.030 ng/L	1	5	0.0256	0.035	
	Total H7CDD	NS 2200	0.030 ng/L	1	5	0.0262	0.038	
	Total H7CDD	OW 1900	0.030 ng/L	1	4	0.0308	0.042	
	Total H7CDD	RL 0100	0.030 ng/L	2	5	0.0624	0.12	
	Total H7CDF	IN 2400	0.030 ng/L	1	5	0.028	0.035	
	Total H7CDF	NS 2200	0.030 ng/L	1	5	0.0286	0.038	
	Octachlorodibenzo–p–dioxin	IN 2400	0.030 ng/L	2	5	0.0192	0.035	
	Octachlorodibenzo–p–dioxin	NS 2200	0.030 ng/L	1	5	0.0236	0.038	
	Octachlorodibenzo–p–dioxin	OW 1900	0.030 ng/L	1	4	0.0298	0.046	
	Octachlorodibenzo–p–dioxin	RL 0100	0.030 ng/L	3	5	0.324	0.75	1
	Octachlorodibenzofuran	IN 2400	0.030 ng/L	2	5	0.0288	0.035	
	Octachlorodibenzofuran	NS 2200	0.030 ng/L	1	5	0.0292	0.038	

Note: This table presents a summary of dioxin and furan data for all streams where a dioxin or furan compound was detected at least once at a level above or equal to the RMDL. Those streams where a dioxin or furan compound is classified as priority 1 are indicated by a '1' under the Priority column.

TABLE 48 (cont'd)

EPG Sector – Detection of Polychlorinateddibenzo–p–dioxins and dibenzofurans

Units as per RMDL

Site	Parameter	Control Point	RMDL	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
18 – Darlington NGS (Under Constr.)	Total TCDF	PR 0800	0.015 ng/L	1	4	0.105	0.38	
	Total PCDF	PR 0800	0.015 ng/L	1	4	0.183	0.69	
	Total H6CDF	PR 0800	0.020 ng/L	1	4	0.219	0.82	
	Total H7CDF	PR 0800	0.030 ng/L	1	4	0.143	0.49	
	Octachlorodibenzo–p–dioxin	PR 0800	0.030 ng/L	1	3	0.0693	0.16	
	Octachlorodibenzofuran	PR 0800	0.030 ng/L	1	4	0.0438	0.093	
19 – Pickering NGS – A & B	Total H7CDD	IN 3400	0.030 ng/L	1	12	0.027	0.062	
	Total H7CDD	RL 0200	0.030 ng/L	1	12	0.0243	0.054	
	Total H7CDF	RL 0200	0.030 ng/L	1	12	0.0271	0.056	
	Octachlorodibenzo–p–dioxin	IN 3400	0.030 ng/L	1	12	0.0494	0.36	
	Octachlorodibenzo–p–dioxin	RL 0200	0.030 ng/L	7	12	0.0807	0.26	1
21 – BNPD Services	Total TCDF	NS 1400	0.015 ng/L	1	12	0.0158	0.045	
	Total TCDF	PR 0400	0.015 ng/L	1	4	0.0135	0.018	
	Total PCDD	NS 1400	0.020 ng/L	1	12	0.02	0.034	
	Total PCDF	NS 1400	0.015 ng/L	1	12	0.0148	0.026	
	Total PCDF	PR 0400	0.015 ng/L	1	4	0.0143	0.018	
	Total H6CDD	PR 0400	0.030 ng/L	1	4	0.024	0.033	
	Total H6CDF	PR 0400	0.020 ng/L	1	4	0.0218	0.033	
	Total H7CDD	NS 1400	0.030 ng/L	1	12	0.0373	0.18	
	Total H7CDF	NS 1400	0.030 ng/L	1	12	0.0396	0.18	
	Octachlorodibenzo–p–dioxin	NS 1400	0.030 ng/L	1	11	0.0256	0.071	
	Octachlorodibenzofuran	NS 1400	0.030 ng/L	1	12	0.0311	0.071	

Note: This table presents a summary of dioxin and furan data for all streams where a dioxin or furan compound was detected at least once at a level above or equal to the RMDL. Those streams where a dioxin or furan compound is classified as priority 1 are indicated by a '1' under the Priority column.

TABLE 49

EPG Sector – Detection of Arsenic RMDL = 5.0 ug/L

Units as per RMDL

Site	Control Point	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
01 – Atikokan TGS	AT 0200	3	52	4.95	7	
	CP 0400	2	7	5.29	6	
	IN 1000	1	50	4.92	6	
	NS 0800	4	50	5.48	30	
02 – J.C. Keith TGS	SW 0100	10	10	11.9	22	1
	SW 0200	1	12	2.17	5	
03 – Lakeview TGS	AT 0200	38	52	8.91	28	1
	CP 1700	5	11	9.14	66	1
	CP 1800	2	16	2.91	6	
	NS 2700	7	52	2.8	18	
	SW 2500	11	12	26.5	83	1
	SW 2600	6	12	4.54	7.5	1
04 – Lambton TGS	AT 0800	5	51	3.18	27	
	CP 1000	2	12	18.9	203	
	IN 0100	1	48	1.96	5	
	NS 1200	5	51	2.47	16	
	SW 1600	3	12	4.17	13	
05 – Lennox TGS	SW 2100	1	11	4.14	27	
06 – Nanticoke TGS	AT 0100	6	53	3.39	25	
	CP 2000	4	10	8.35	25	1
	CP 2100	5	10	5	10	1
	NS 2800	4	47	2.68	7.5	
	PR 0300	2	25	2.48	6	
	SW 2500	3	10	4.15	14.5	
	SW 2600	1	10	2.35	6.5	
	SW 2700	2	10	2.95	8.5	
	SW 2750	9	9	19.1	55	1

Note: This table presents a summary of arsenic data for all streams where arsenic was detected at least once at a level above or equal to the RMDL.
Those streams where arsenic is classified as priority 1 are indicated by a '1' under the Priority column.

TABLE 49 (cont'd)

EPG Sector – Detection of Arsenic RMDL = 5.0 ug/L

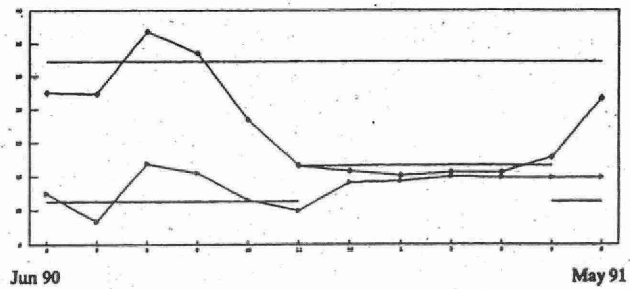
Units as per RMDL

Site	Control Point	N > RMDL	N	Average Concentration	Maximum Concentration	Priority
07 – RL Hearn TGS	SW 0100	3	11	4.82	14	
08 – Thunder Bay TGS	AT 0200	4	52	4.95	7	
	CP 0700	2	12	5.23	9	
	NS 1500	1	46	4.93	7	
09 – Aquasabon GS	SW 0200	10	12	61	546	1
10 – Arnprior GS	SW 0300	1	11	4.45	27.5	
11 – Decew Falls NF 23 GS	SW 0400	14	15	80.4	202	1
	SW 0500	8	15	11.3	68	1
12 – Pine Portage GS	SW 0300	8	11	5.56	7	1
13 – Silver Falls GS	SW 0200	2	8	5.03	7	
14 – Sir Adam Beck 2 GS	SW 1100	12	12	310	440	1
	SW 1200	6	12	6.88	19	1
15 – Bruce NGS – A	OW 1100	3	4	36	120	1
16 – Bruce NGS – B	NS 2000	1	4	3.88	7.5	
18 – Darlington NGS (Under Constr.)	BB 0200	2	52	2.15	6.5	
	EC 0700	3	12	3.42	11	
	IN 1200	1	52	1.77	6.5	
19 – Pickering NGS – A & B	BB 1100	1	2	5	8	
21 – BNPD Services	NS 1400	1	4	3.98	5	

Note: This table presents a summary of arsenic data for all streams where arsenic was detected at least once at a level above or equal to the RMDL.
Those streams where arsenic is classified as priority 1 are indicated by a '1' under the Priority column.

TABLE 50
Fossil Fuelled Stations
Summary of Monthly Maximum Temperature Data, °C
(From June 1990 To May 1991)

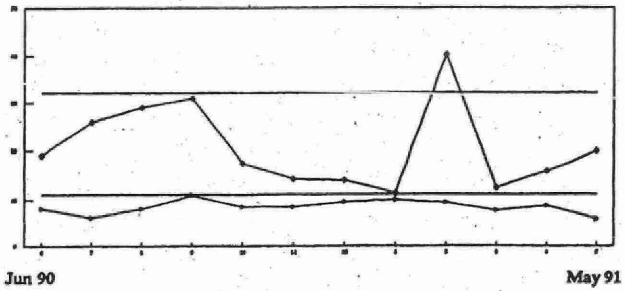
	Jun 90	Jul 90	Aug 90	Sep 90	Oct 90	Nov 90	Dec 90	Jan 91	Feb 91	Mar 91	Apr 91	May 91
Atikokan TGS OT 33 0100 CCW – Outfall												
Temp. Effluent Maximum	27.4	27.2	36.8*	33.4*	23.4	16.6	15.8	15.1	15.6	15.6	17.8	26.6
Temp. Rise Maximum	12.4	8.2	16.8*	15.4	11.4	9.9	14.0	14.2	14.9	14.8	14.8	14.8



Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.2 °C : May – Oct. , 16.6 °C : Nov. – Apr.)

Lakeview TGS OT 33 0100 CCW – Outfall												
Temp. Effluent Maximum	19.0	26.0	29.0	31.0	17.5	14.1	13.7	11.2	40.2*	12.2	15.8	19.8
Temp. Rise Maximum	8.0	6.0	8.0	11.0	8.3	8.3	9.4	9.9	9.3	7.6	8.7	5.6



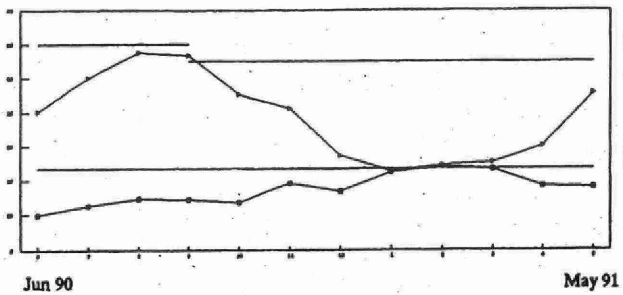
Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.1 °C)

* Numbers above the Guideline

TABLE 50 (cont'd)
Fossil Fuelled Stations
Summary of Monthly Maximum Temperature Data, °C
(From June 1990 To May 1991)

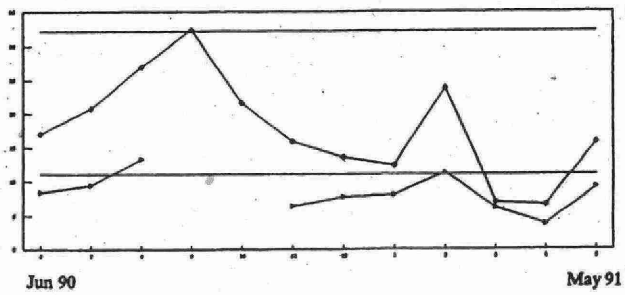
	Jun 90	Jul 90	Aug 90	Sep 90	Oct 90	Nov 90	Dec 90	Jan 91	Feb 91	Mar 91	Apr 91	May 91
Lambton TGS OT 33 0200 CCW Outfall												
Temp. Effluent Maximum	25.0	30.0	33.8	33.4	27.7	25.6	18.6	16.2	17.2	17.6	20.1	27.8
Temp. Rise Maximum	9.9	11.4	12.4	12.2	11.8	14.5	13.3	16.2	17.0*	16.6	14.1	13.9



Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW
(35 °C : Jun. – Sep. , 32.5 °C :Oct. – May)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (16.7 °C)

Lennox TGS OT 33 0200 CW – CCW Outfall												
Temp. Effluent Maximum	17.0	20.8	27.0	32.4*	21.6	15.9	13.6	12.4	23.8	7.1	6.6	15.8
Temp. Rise Maximum	8.5	9.5	13.4*	N/A	N/A	6.4	7.8	8.2	11.3*	6.1	3.8	9.3



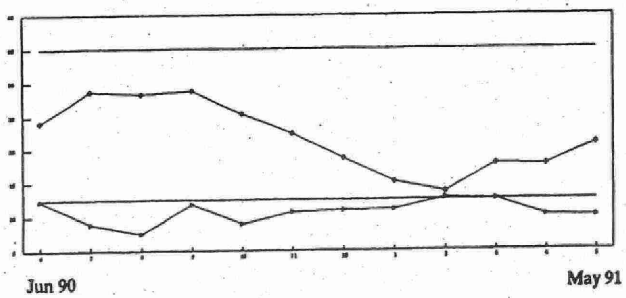
Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.1 °C)

* Numbers above the Guideline

TABLE 50 (cont'd)
Fossil Fuelled Stations
Summary of Monthly Maximum Temperature Data, °C
(From June 1990 To May 1991)

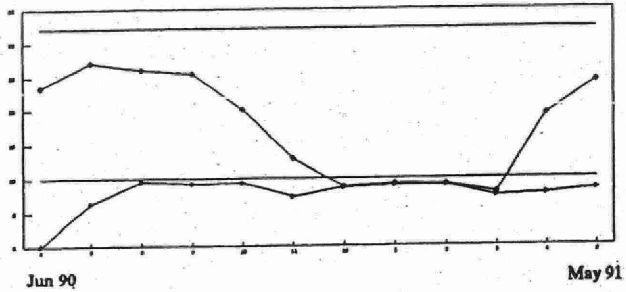
	Jun 90	Jul 90	Aug 90	Sep 90	Oct 90	Nov 90	Dec 90	Jan 91	Feb 91	Mar 91	Apr 91	May 91
Nanticoke TGS OT 33 0200 CCW – Outfall												
Temp. Effluent Maximum	24.1	28.6	28.2	28.7	25.4	22.4	18.7	15.1	13.6	17.8	17.7	20.8
Temp. Rise Maximum	12.3	9.0	7.5	11.8	9.0	10.6	10.9	11.0	12.7*	12.5	10.0	9.9



Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (35 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (12.5 °C)

Thunder Bay TGS OT 33 0100 CCW – Outfall												
Temp. Effluent Maximum	23.3	27.2	26.1	25.4	20.0	12.8	8.7	9.1	9.0	7.7	19.2	24.2
Temp. Rise Maximum	.0	6.4	9.5	9.1	9.3	7.3	8.5	8.8	8.8	7.3	7.5	8.2



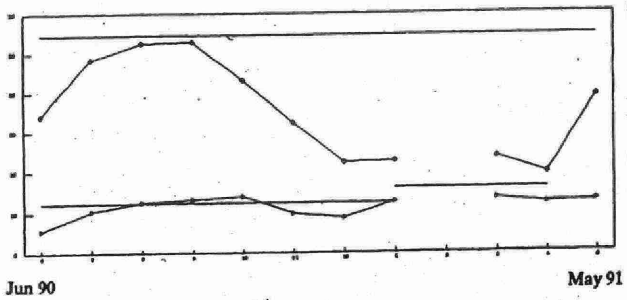
Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (10 °C)

* Numbers above the Guideline

TABLE 51
Nuclear Powered Stations
Summary of Monthly Maximum Temperature Data, °C
(From June 1990 To May 1991)

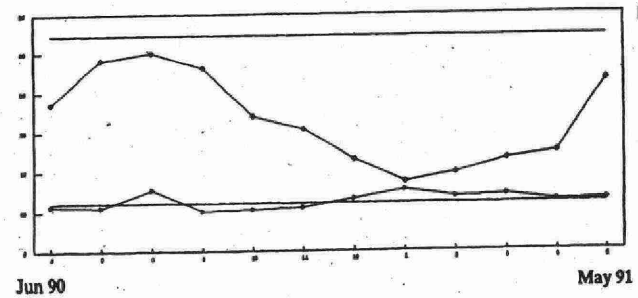
	Jun 90	Jul 90	Aug 90	Sep 90	Oct 90	Nov 90	Dec 90	Jan 91	Feb 91	Mar 91	Apr 91	May 91
Bruce NGS – A OT 33 1000 CCW Outfall												
Temp. Effluent Maximum	22.1	29.2	31.2	31.4	26.5	21.2	16.1	16.3	N/A	16.8	14.7	24.4
Temp. Rise Maximum	7.8	10.2	11.2*	11.5*	11.9*	9.8	9.3	11.2	N/A	11.5	10.9	11.3*



Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.1 °C : Apr. – Dec. , 13 °C Jan. – Mar.)

Bruce NGS – B OT 33 1400 CCW – Outfall												
Temp. Effluent Maximum	23.5	29.1	30.0	28.1	22.0	20.4	16.6	13.8	14.9	16.7	17.5	26.4
Temp. Rise Maximum	10.7	10.5	12.9*	10.1	10.3	10.5	11.7*	12.8*	11.9*	12.1*	11.4*	11.5*



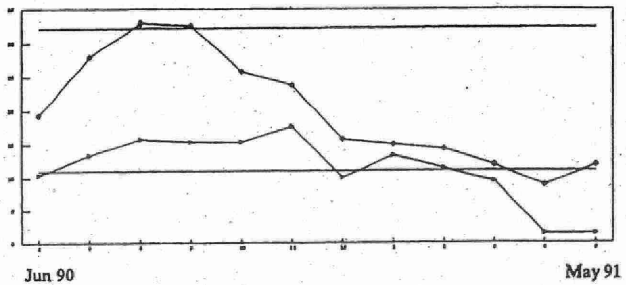
Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.1 °C)

* Numbers above the Guideline

TABLE 51 (cont'd)
Nuclear Powered Stations
Summary of Monthly Maximum Temperature Data, °C
(From June 1990 To May 1991)

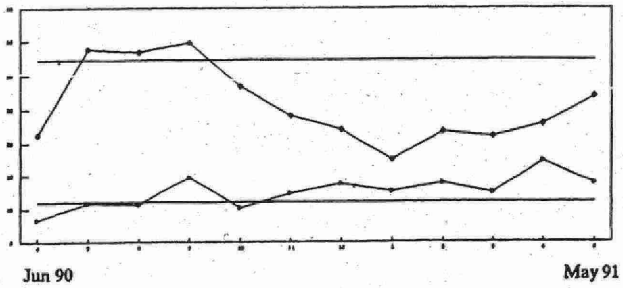
	Jun 90	Jul 90	Aug 90	Sep 90	Oct 90	Nov 90	Dec 90	Jan 91	Feb 91	Mar 91	Apr 91	May 91
Darlington NGS OT 33 1800 CCW – Outfall												
Temp. Effluent Maximum	19.3	27.9	32.9*	32.5*	25.8	23.6	15.7	14.9	14.2	11.9	8.8	11.9
Temp. Rise Maximum	10.5	13.4*	15.7*	15.3*	15.3*	17.6*	10.0	13.3*	11.4*	9.4	1.4	1.4



Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.1 °C)

Pickering NGS – A & B OT 33 2100 CCW Unit 1,2 A												
Temp. Effluent Maximum	21.3	33.8*	33.4*	34.8*	28.3	24.0	22.0	17.4	21.7	21.0	22.8	26.8
Temp. Rise Maximum	8.3	10.8	10.7	14.7*	10.2	12.3*	13.8*	12.6*	13.9*	12.3*	17.2*	13.8*



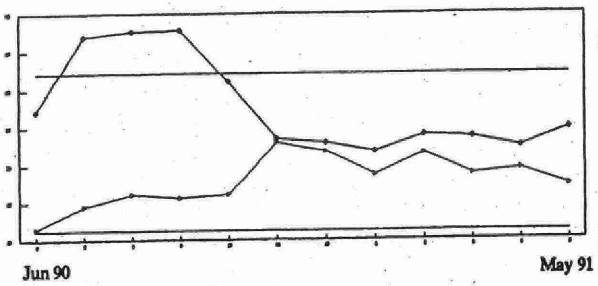
Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.1 °C)

* Numbers above the Guideline

TABLE 51 (cont'd)
Nuclear Stations
Summary of Monthly Maximum Temperature Data, °C
(From June 1990 To May 1991)

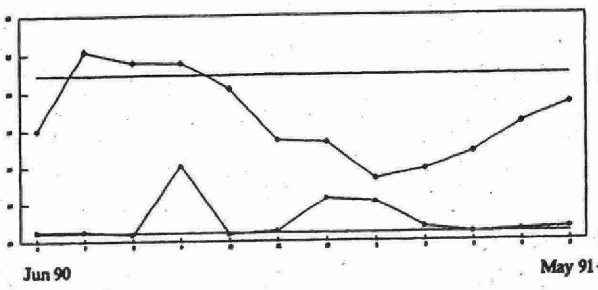
	Jun 90	Jul 90	Aug 90	Sep 90	Oct 90	Nov 90	Dec 90	Jan 91	Feb 91	Mar 91	Apr 91	May 91
Pickering NGS – A & B OT 33 2300 CW – RBSWNGS – A												
Temp. Effluent Maximum	27.1	36.9*	37.6*	37.8*	31.0	23.5	22.9	21.8	24.0	23.7	22.4	24.7
Temp. Rise Maximum	11.4*	14.4*	16.0*	15.6*	16.0*	23.0*	21.9*	18.7*	21.6*	18.8*	19.5*	17.3*



Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.1 °C)

Pickering NGS – A & B OT 33 3200 CCW NGS B												
Temp. Effluent Maximum	25.0	35.3*	33.9*	33.8*	30.5	23.5	23.2	18.3	19.6	22.0	25.9	28.4
Temp. Rise Maximum	11.3*	11.3*	10.9	20.2*	11.0	11.4*	15.7*	15.3*	11.8*	11.2*	11.4*	11.8*



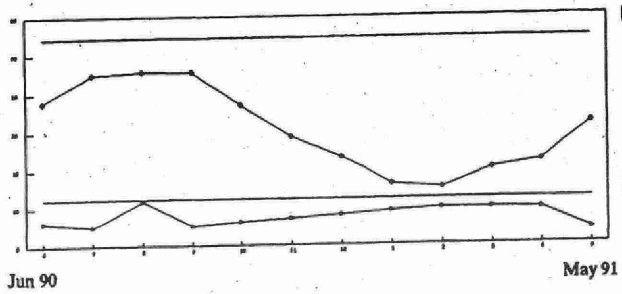
Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.1 °C)

* Numbers above the Guideline

TABLE 52
Bruce Heavy Water Plant
Summary of Monthly Maximum Temperature Data, °C
(From June 1990 To May 1991)

	Jun 90	Jul 90	Aug 90	Sep 90	Oct 90	Nov 90	Dec 90	Jan 91	Feb 91	Mar 91	Apr 91	May 91
Bruce Heavy Water Plant OT 33 0200 CCW – Outfall												
Temp. Effluent Maximum	23.9	27.5	27.9	27.8	23.5	19.3	16.6	13.1	12.6	15.0	16.0	21.0
Temp. Rise Maximum	8.1	7.5	10.8	7.6	8.1	8.5	9.0	9.5	9.8	9.8	9.8	6.9



Upper Horizontal Line: MOE Gudeline for Max. Temp. of CCW (32.2 °C)

Lower Horizontal Line: MOE Gudeline for Max. Temp. Rise of CCW (11.1 °C)

* Numbers above the Guideline

Table 53
MISA Electric Power Generation Sector - List of Monitoring Control Points

Company Identification	Control Point			Effluent Description
Fossil Stations				
1 - Atikokan TGS	AT	30	0200	Ash Transport System
	NS	30	0800	WTP - Neutralization Sump
	OW	30	0600	Oily Water Separator
	OT	33	0100	CCW - Outfall
	CP	34	0400	Coal Pile Runoff
	SW	34	0700	Yard Catch Basin
	EO	36	0500	Ash Transport System
	EO	36	1300	Sludge Sump
	RG	42	0900	Rain Gauge
	IN	43	1000	Intake Water
	BB	48	0300	Boiler Blowdown
2 - J.C. Keith TGS	SW	34	0100	Ash Lagoon Ditch
	SW	34	0200	Yard Drain - Power House
	RG	42	0300	Rain Gauge
3 - Lakeview TGS	AT	30	0200	Ash Transport
	NS	30	2700	WTP - Neutralization Sump
	OW	30	2300	Oily Water Powerhouse
	OW	30	2400	Oily Water Pumphouse
	OT	33	0100	CCW - Outfall
	OT	33	3100	Chlorination Unit 1 Condenser
	OT	33	3200	Chlorination Unit 2 Condenser
	OT	33	3300	Chlorination Unit 3 Condenser
	CP	34	1700	Coal Pile Runoff
	SW	34	2500	South Yard Drain
	SW	34	2600	North Yard Drain
	BE	35	0300	Building Effluent - Unit 3
	BE	35	0400	Building Effluent - Unit 4
	BE	35	0500	Building Effluent - Unit 5
	BE	35	0600	Building Effluent - Unit 6
	BE	35	0700	Building Effluent - Unit 1,2
	BE	35	0800	Building Effluent - Unit 7,8
	BE	35	3000	Unit 5-8 Pump House Sump
	EC	35	1900	Boiler Wash/Clean
	EC	35	2000	Air Pre-heater Wash
	EO	36	2100	Ash Filtration Plant - East
	EO	36	2200	Coal Pile Runoff
	EO	36	3900	Ash Filtration Plant - West
	RG	42	2800	Rain Gauge

Table 53 (continued)
MISA Electric Power Generation Sector - List of Monitoring Control Points

Company Identification	Control Point			Effluent Description
Fossil Stations (continued)				
	IN	43	2900	Intake Water
	BB	48	0900	Boiler Blowdown - Unit 1
	BB	48	1000	Boiler Blowdown - Unit 2
	BB	48	1100	Boiler Blowdown - Unit 3
	BB	48	1200	Boiler Blowdown - Unit 4
	BB	48	1500	Boiler Blowdown - Unit 7
	BB	48	1600	Boiler Blowdown - Unit 8
	CP	49	1800	Event Discharge - Coal Pile
4 - Lambton TGS	AT	30	0800	Ash Transport
	NS	30	1200	WTP - Neutralization Sump
	OT	33	0200	CCW - Outfall
	OT	33	1300	CW - Unit 1 Transformer
	OT	33	1800	CW - Unit 2 Transformer
	OT	33	2400	Chlorination Unit 1 Condenser
	OT	33	2500	Chlorination Unit 2 Condenser
	OT	33	2600	Chlorination Unit 3 Condenser
	CP	34	1000	Effluent - Bowman's Pit
	SW	34	1600	North Yard
	BE	35	0900	North Building Drain
	BE	35	1900	Administrative Building
	BE	35	2000	Bldg. Eff. Unit 1,2 Pump House
	BE	35	2100	Bldg. Eff. Unit 3,4 Pump House
	BE	35	2200	Coal Yard Maintenance Garage
	EC	35	1400	Air Preheater Wash
	EC	35	1500	Boilerwash/Clean
	EO	36	0300	Ash Filtration Plant
	RG	42	1700	Rain Gauge
	IN	43	0100	Intake
	BB	48	0400	Boiler Blowdown Unit 1
	BB	48	0500	Boiler Blowdown Unit 2
	BB	48	0600	Boiler Blowdown Unit 3
	BB	48	0700	Boiler Blowdown Unit 4
	CP	49	1100	Event Discharge - Lake Lambton
5 - Lennox TGS	NS	30	2300	WTP - Neut. Sump Settling Pond
	OW	30	0300	Oily Water Separator Pond
	OT	33	0200	CCW - Outfall
	OT	33	1500	CW - Unit 1,2 Transformer
	OT	33	1600	CW - Unit 3,4 Transformer
	SW	34	2100	West Yard Drain Manhole #7

Table 53 (continued)
MISA Electric Power Generation Sector - List of Monitoring Control Points

Company Identification	Control Point			Effluent Description
Fossil Stations (continued)				
	SW	34	2200	East Yard Drainage
	BE	35	0600	Pumphouse Sump
	BE	35	0700	Building Effluent Unit 1 Sump
	BE	35	0800	Building Effluent Unit 2 Sump
	BE	35	0900	Building Effluent Unit 3 Sump
	BE	35	1000	Building Effluent Unit 4 Sump
	RG	42	1900	Rain Gauge
	IN	43	2000	Intake Water
	BB	48	1100	Boiler Blowdown Unit 1
	BB	48	1200	Boiler Blowdown Unit 2
	BB	48	1300	Boiler Blowdown Unit 3
	BB	48	1400	Boiler Blowdown Unit 4
6 - Nanticoke TGS	AT	30	0100	Ash Lagoon
	NS	30	2800	WTP - Neutralization Sump
	PR	30	0300	Ash Transport Lines
	OT	33	0200	CCW - Outfall
	OT	33	3100	Chlorination Unit 1 Condenser
	OT	33	3300	Chlorination Unit 3 Condenser
	OT	33	3400	Chlorination Unit 4 Condenser
	OT	33	3500	Chlorination Unit 5 Condenser
	OT	33	3700	Chlorination Unit 7 Condenser
	OT	33	3800	Chlorination Unit 8 Condenser
	CP	34	2000	Runoff NE Sump
	CP	34	2100	Runoff NW Sump
	SW	34	2500	East
	SW	34	2600	South
	SW	34	2700	West
	SW	34	2750	Truck Wash Station
	BE	35	0400	Unit 1 Manhole # 16
	BE	35	0500	Unit 2 Manhole # 14
	BE	35	0600	Unit 3 Manhole # 13
	BE	35	0700	Unit 4 Manhole # 12
	BE	35	0800	Unit 5 - Sump 5
	BE	35	0900	Unit 6 - Sump 6
	BE	35	1000	Unit 7 - Sump 7
	BE	35	1100	Unit 8 - Sump 8
	BE	35	1101	Pumphouse Unit 1,2
	BE	35	1102	Pumphouse Unit 3,4
	BE	35	1103	Pumphouse Unit 5,6
	BE	35	1104	Pumphouse Unit 7,8

Table 53 (continued)
MISA Electric Power Generation Sector - List of Monitoring Control Points

Company Identification	Control Point			Effluent Description
Fossil Stations (continued)				
	EC	35	2206	Boiler A Wash U6
	EC	35	2220	External Boiler Wash U2
	EC	35	2240	External Boiler Wash U4
	EC	35	2270	External Boiler Wash U7
	EC	35	2310	Preheat Wash U12
	EC	35	2320	Preheat Wash U34
	EC	35	2330	Preheat Wash U56
	EC	35	2340	Preheat Wash U78
	EO	36	2400	Neutralization Sump Overflow
	RG	42	2900	Rain Gauge
	IN	43	3000	Intake Water
	BB	48	1200	Boiler Blowdown - Unit 1
	BB	48	1300	Boiler Blowdown - Unit 2
	BB	48	1400	Boiler Blowdown - Unit 3
	BB	48	1500	Boiler Blowdown - Unit 4
	BB	48	1600	Boiler Blowdown - Unit 5
	BB	48	1700	Boiler Blowdown - Unit 6
	BB	48	1800	Boiler Blowdown - Unit 7
	BB	48	1900	Boiler Blowdown - Unit 8
7 - RL Hearn TGS	OT	33	0300	CW - Outfall
	SW	34	0100	Sumphouse 1
	BE	35	0200	Pumphouse 3
	RG	42	0500	Rain Gauge
	IN	43	0600	Intake Water
8 - Thunder Bay TGS	AT	30	0200	Ash Transport System
	NS	30	1500	WTP - Neutraliztion Sump
	OW	30	1100	Oily Water Separator
	OT	33	0100	CCW - Outfall
	CP	34	0700	Coal Pile Runoff
	SW	34	1200	Combustion Turbine Units
	SW	34	1300	Roadway Drains
	EO	36	1000	Surge
	RG	42	1600	Rain Gauge
	IN	43	1700	Intake Water
	BB	48	0500	Boiler Blowdown -Unit 2
	BB	48	0600	Boiler Blowdown - Unit 3

Table 53 (continued)
MISA Electric Power Generation Sector - List of Monitoring Control Points

Company Identification	Control Point			Effluent Description
Hydraulic Stations				
9 - Aquasabon GS	SW	34	0200	Yard Drain
	BE	35	0100	Sump Effluent
	RG	42	0300	Rain Gauge
	IN	43	0400	Intake Water
10 - Arnprior GS	SW	34	0300	Transformer Area
	BE	35	0100	Sump S1
	BE	35	0200	Sump S2
	RG	42	0400	Rain Gauge
	IN	43	0500	Intake Water
11 - Decew Falls NF 23 GS	OT	33	0200	CW - Transformer 1
	OT	33	0300	CW - Transformer 2
	SW	34	0400	Switch Yard
	SW	34	0500	Transformer Area
	BE	35	0100	Sump S1
	RG	42	0600	Rain Gauge
	IN	43	0700	Intake
12 - Pine Portage GS	SW	34	0300	Yard Drain
	BE	35	0100	Sump Unit 1,2
	BE	35	0200	Sump Unit 3,4
	RG	42	0400	Rain Gauge
	IN	43	0500	Intake Water
13 - Silver Falls GS	SW	34	0200	Yard Drain
	BE	35	0100	Sump Effluent
	RG	42	0300	Rain Gauge
	IN	43	0400	Intake Water
14 - Sir Adam Beck 2 GS	OT	33	0900	CW - Transformer 15
	OT	33	1000	CW - Transformer 17
	SW	34	1100	Switch Yard
	SW	34	1200	Transformer
	BE	35	0100	Sump S11
	BE	35	0200	Sump S13
	BE	35	0300	Sump S15
	BE	35	0400	Sump S17
	BE	35	0500	Sump S19
	BE	35	0600	Sump S21
	BE	35	0700	Sump S23
	BE	35	0800	Sump S25
	RG	42	1300	Rain Gauge
	IN	43	1400	Intake

Table 53 (continued)
MISA Electric Power Generation Sector - List of Monitoring Control Points

Company Identification	Control Point			Effluent Description
Nuclear Stations and Associated Facilities				
15 - Bruce NGS - A	NS	30	1400	WTP - Neutralization Sump
	RL	32	0100	RLWM Tanks
	OT	33	1000	CCW - Outfall
	SW	34	1300	Manhole 35
	BE	35	0200	Reheater Drain Unit 1
	BE	35	0300	Reheater Drain Unit 2
	BE	35	0400	Reheater Drain Unit 3
	BE	35	0500	Reheater Drain Unit 4
	RG	42	1600	Rain Gauge
	IN	43	1500	Intake Water
	BB	48	0600	Boiler Blowdown Unit 1
	BB	48	0800	Boiler Blowdown Unit 3
	BB	48	0900	Boiler Blowdown Unit 4
	OW	49	1100	Oily Water Separator
16 - Bruce NGS - B	NS	30	2000	WTP - Neutralization Sump
	RL	32	0100	RLWM Tanks
	OT	33	1400	CCW - Outfall
	SW	34	1700	Manhole 1
	SW	34	1800	Manhole 28
	SW	34	1900	Manhole 8
	BE	35	0200	Inactive Drain Unit 5
	BE	35	0300	Inactive Drain Unit 6
	BE	35	0400	Inactive Drain Unit 7
	BE	35	0500	Inactive Drain Unit 8
	BE	35	0600	Reheater Drain Unit 5
	BE	35	0700	Reheater Drain Unit 6
	BE	35	0800	Reheater Drain Unit 7
	BE	35	0900	Reheater Drain Unit 8
	EC	35	2300	Boiler Layup Unit 5
	EC	35	2600	Boiler Layup Unit 8
	RG	42	2200	Rain Gauge
	IN	43	2100	Intake Water
	BB	48	1000	Boiler Blowdown Unit 5
	BB	48	1100	Boiler Blowdown Unit 6
	BB	48	1200	Boiler Blowdown Unit 7
	BB	48	1300	Boiler Blowdown Unit 8
	OW	49	1600	Oily Water Separator

Table 53 (continued)
MISA Electric Power Generation Sector - List of Monitoring Control Points

Company Identification	Control Point			Effluent Description
Nuclear Stations and Associated Facilities (continued)				
17 - Darlington NGS	NS	30	2200	WTP - Neutralization Sump
	RL	32	0100	RLWM Tanks
	OT	33	1800	CCW - Outfall
	SW	34	2000	Manhole 214
	SW	34	2100	Manhole 804
	BE	35	0200	CSA Sump
	BE	35	0300	Emerg. Service Water Pumphouse
	BE	35	0400	Heavy Water Mgmt. Bldg. Sump
	BE	35	0500	Unit 1 Pumphouse
	BE	35	0600	Unit 2 Pumphouse
	BE	35	0700	Unit 1 - Sump 1 (A)
	BE	35	0800	Unit 1 - Sump 2 (B)
	BE	35	0900	Unit 1 - Sump 3 (C)
	BE	35	1000	Unit 1 - Sump 4 (D)
	BE	35	1100	Unit 1 - Sump 5 (E)
	BE	35	1200	Unit 2 - Sump 1
	BE	85	1300	Unit 2 - Sump 2
	BE	35	1400	Unit 2 - Sump 3
	BE	35	1500	Unit 2 - Sump 4
	BE	35	1600	WTP - Sump
	BE	35	2500	Unit 2 - Sump 5
	RG	42	2300	Rain Gauge
	IN	43	2400	Intake Water
	BB	48	1700	Boiler Blowdown Unit 2
	BB	48	2600	Boiler Blowdown Unit 1
	EC	48	2700	Heating Steam Condensate
	OW	49	1900	Oily Water Separator
18 - Darlington NGS (Under Constr.)	NS	30	1100	WTP - Neutralization Sump
	PR	30	0800	Sewage Treatment
	OT	33	0300	CW - Compressors
	SW	34	0900	South East Corner Drain
	SW	34	1000	Shops Warehouse Drain
	EC	35	0400	Waste Lagoon
	EC	35	0500	Waste Lagoon
	EC	35	0600	Tank 2
	EC	35	0700	Tank 4
	WD	35	1300	Waste Settlement Pond
	RG	42	1400	Rain Gauge
	IN	43	1200	Bowmanville City Water
	BB	48	0100	Trit. Removal Fac. Boiler Blwdwn.
	BB	48	0200	Boiler Blowdown Effluent

Table 53 (continued)
MISA Electric Power Generation Sector - List of Monitoring Control Points

Company Identification	Control Point			Effluent Description
Nuclear Stations and Associated Facilities (continued)				
19 - Pickering NGS - A & B	NS	30	3100	WTP - Neutralization Sump
	RL	32	0200	RLWM Tanks A
	RL	32	3700	RLWM Tanks B
	OT	33	1900	CCW - Unit 3A
	OT	33	2000	CCW - Unit 4A
	OT	33	2100	CCW - Unit 1,2 - A
	OT	33	2200	CW - Aux. Irradiated Fuel Bay
	OT	33	2300	CW - Reactor Bldg. Serv. Wat./NGS - A
	OT	33	2400	CW - Reactor Bldg. Serv. Wat./NGS - B
	OT	33	2500	CW - Heavy Wat. Upgrader (Sulzer) - A
	OT	33	2600	CW - Heavy Water Upgrader (UPP)
	OT	33	3200	CCW - NGS B
	OT	33	3300	CW - Heavy Wat. Upgrader (Sulzer) - B
	SW	34	2800	CB 70
	SW	34	2900	Manhole 37
	SW	34	3000	Manhole 85
	BE	35	0100	Building Effluent - Unit 8
	BE	35	0300	Building Effluent - Unit 1
	BE	35	0400	Building Effluent - Unit 2
	BE	35	0500	Building Effluent - Unit 3
	BE	35	0600	Building Effluent - Unit 4
	BE	35	0700	Building Effluent - Unit 5
	BE	35	0800	Building Effluent - Unit 6
	BE	35	0900	Building Effluent - Unit 7
	EC	35	3800	Boiler Layup Effluent
	RG	42	3500	Rain Gauge
	IN	43	3400	Intake Water
	BB	48	1100	Boiler Blowdown Unit 1
	BB	48	1200	Boiler Blowdown Unit 2
	BB	48	1400	Boiler Blowdown Unit 4
	BB	48	1500	Boiler Blowdown Unit 5
	BB	48	1600	Boiler Blowdown Unit 6
	BB	48	1700	Boiler Blowdown Unit 7
	BB	48	1800	Boiler Blowdown Unit 8
	OW	49	2700	Oily Water Separator - B
	OW	49	3600	Oily Water Separator A

Table 53 (continued)
MISA Electric Power Generation Sector - List of Monitoring Control Points

Company Identification	Control Point			Effluent Description
Nuclear Stations and Associated Facilities (continued)				
20 - Bruce Heavy Water Plant	PR	30	0500	Process Effluent
	OT	33	0200	CCW - Outfall
	SW	34	0700	Low Pressure Condensate Area
	SW	34	0800	North Flare
	BE	35	0100	Clarifier Building
	EC	35	0300	Carbonated Equipment/Drain
	EC	35	0600	Surface Water Treatment
	RG	42	1000	Rain Gauge
	IN	43	0900	Intake Water
	PR	49	0400	Effluent Lagoon
21 - BNPD Services	NS	30	1400	WTP - Neutralization Sump
	PR	30	0100	Sewage Treatment Plant
	PR	31	0200	STP - A Lake
	PR	31	0300	STP - A NGS A
	PR	31	0400	Steam Plant- STP O
	OT	33	1500	CCW - Outfall BNPDS
	SW	34	0700	Chemical Laydown
	SW	34	0800	Douglas Point Ditch
	SW	34	0900	East boundary Ditch
	SW	34	1000	NGS - A Switch Yard
	SW	34	1100	NGS - B Swith Yard
	SW	34	1200	Oil Unloading
	EC	35	0600	Chemical Waste Pond
	WD	35	1300	Waste Disposal
	RG	42	1600	Rain Gauge

Table 54
Parameter List

ATG	Parameter	RMDL		ATG	Parameter	RMDL		ATG	Parameter	RMDL	
01	COD	10	mg/L	16	Tetrachloroethylene	1.1	ug/L	20	2,6-Dichlorophenol	2	ug/L
02	Cyanide Total	0.005	mg/L		Trans-1,2-Dichloroethylene	1.4	ug/L		2-Chlorophenol	3.7	ug/L
03	Hydrogen ion (pH)				Trans-1,3-Dichloropropylene	1.4	ug/L		4,6-Dinitro-o-cresol	24	ug/L
	pH, Average Daily				Trichloroethylene	1.9	ug/L		4-Chloro-3-methylphenol	1.5	ug/L
	pH, Maximum Daily				Trichlorofluoromethane	1	ug/L		4-Nitrophenol	1.4	ug/L
	pH, Minimum Daily				Vinyl chloride	4	ug/L		Pentachlorophenol	1.3	ug/L
04	Ammonia plus Ammonium	0.25	mg/L	17	Benzene	0.5	ug/L		Phenol	2.4	ug/L
	Nitrate + Nitrite	0.25	mg/L		Styrene	0.5	ug/L		m-Cresol	3.4	ug/L
	Total Kjeldahl nitrogen	0.5	mg/L		Toluene	0.5	ug/L		o-Cresol	3.7	ug/L
05	DOC	0.5	mg/L		m-Xylene and p-Xylene	1.1	ug/L		p-Cresol	3.5	ug/L
	TOC	5	mg/L		o-Xylene	0.5	ug/L	23	1,2,3,4-Tetrachlorobenzene	0.01	ug/L
06	Total phosphorus	0.1	mg/L	19	1-Chloronaphthalene	2.5	ug/L		1,2,3,5-Tetrachlorobenzene	0.01	ug/L
07	Conductivity, average	5	uS/cm		1-Methylnaphthalene	3.2	ug/L		1,2,3-Trichlorobenzene	0.01	ug/L
	Conductivity, maximum		uS/cm		2,4-Dinitrotoluene	0.8	ug/L		1,2,4,5-Tetrachlorobenzene	0.01	ug/L
	Conductivity, minimum		uS/cm		2,6-Dinitrotoluene	0.7	ug/L		1,2,4-Trichlorobenzene	0.01	ug/L
	Specific conductance	5	uS/cm		2-Chloronaphthalene	1.8	ug/L		2,4,5-Trichlorotoluene	0.01	ug/L
08	Total suspended solids	5	mg/L		2-Methylnaphthalene	2.2	ug/L		Hexachlorobenzene	0.01	ug/L
	Volatile suspended solids	10	mg/L		4-Bromophenyl phenyl ether	0.3	ug/L		Hexachlorobutadiene	0.01	ug/L
09	Aluminum	30	ug/L		4-Chlorophenyl phenyl ether	0.9	ug/L		Hexachlorocyclopentadiene	0.01	ug/L
	Beryllium	10	ug/L		5-nitro, Acenaphthene	4.3	ug/L		Hexachloroethane	0.01	ug/L
	Boron	50	ug/L		Acenaphthene	1.3	ug/L		Octachlorostyrene	0.01	ug/L
	Cadmium	2	ug/L		Acenaphthylene	1.4	ug/L		Pentachlorobenzene	0.01	ug/L
	Chromium	20	ug/L		Anthracene	1.2	ug/L	24	2,3,7,8 TCDD	0.02	ng/L
	Cobalt	20	ug/L		Benz(a)anthracene	0.5	ug/L		Octachlorodibenzo-p-dioxin	0.03	ng/L
	Copper	10	ug/L		Benzo(a)pyrene	0.6	ug/L		Octachlorodibenzofuran	0.03	ng/L
	Lead	30	ug/L		Benzo(b)fluoranthene	0.7	ug/L		Total H6CDD	0.03	ng/L
	Lithium	50	ug/L		Benzo(g,h,i)perylene	0.7	ug/L		Total H6CDF	0.02	ng/L
	Molybdenum	20	ug/L		Benzo(k)fluoranthene	0.7	ug/L		Total H7CDD	0.03	ng/L
	Nickel	20	ug/L		Benzylbutylphthalate	0.6	ug/L		Total H7CDF	0.03	ng/L

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Table 54 (continued)
Parameter List

ATG	Parameter	RMDL	ATG	Parameter	RMDL	ATG	Parameter	RMDL
09	Silver	30 ug/L	19	Biphenyl	0.6 ug/L	24	Total PCDD	0.02 ng/L
	Strontium	20 ug/L		Bis(2-chloroethoxy)methane	3.5 ug/L		Total PCDF	0.015 ng/L
	Thallium	30 ug/L		Bis(2-chloroethyl)ether	4.4 ug/L		Total TCDD	0.02 ng/L
	Vanadium	30 ug/L		Bis(2-chloroisopropyl)ether	2.2 ug/L		Total TCDF	0.015 ng/L
	Zinc	10 ug/L		Bis(2-ethylhexyl) phthalate	2.2 ug/L	25	Oil and grease	1 mg/L
10	Antimony	5 ug/L		Camphene	3.5 ug/L	27	PCBT	0.1 ug/L
	Arsenic	5 ug/L		Chrysene	0.3 ug/L	98	Discharge Duration	h
	Selenium	5 ug/L		Di-n-butyl phthalate	3.8 ug/L		Flow, Average	m3/day
11	Chromium (hexavalent)	10 ug/L		Di-n-octyl phthalate	2 ug/L		Flow, Maximum	m3/day
12	Mercury	0.1 ug/L		Dibenz(a,h)anthracene	1.3 ug/L		Flow, Minimum	m3/day
14	Phenolics (4AAP)	2 ug/L		Diphenyl ether	0.4 ug/L		Ftflow	m3/day
15	Sulphide	0.02 mg/L		Diphenylamine	14 ug/L		Number of Batch Discharges	
16	1,1,2,2-Tetrachloroethane	4.3 ug/L		Fluoranthene	0.4 ug/L		Precipitation Gauge Depth	mm
	1,1,2-Trichloroethane	0.6 ug/L		Fluorene	1.7 ug/L		Storm Duration	h
	1,1-Dichloroethane	0.8 ug/L		Indeno(1,2,3-cd)pyrene	1.3 ug/L		Temp. Effluent Maximum	°C
	1,1-Dichloroethylene	2.8 ug/L		Indole	1.9 ug/L		Temp. Effluent Mean	°C
	1,2-Dichlorobenzene	1.4 ug/L		N-Nitrosodi-n-propylamine	3.1 ug/L		Temp. Effluent Minimum	°C
	1,2-Dichloroethane	0.8 ug/L		N-Nitrosodiphenylamine	14 ug/L		Temp. Influent Maximum	°C
	1,2-Dichloropropane	0.9 ug/L		Naphthalene	1.6 ug/L		Temp. Influent Mean	°C
	1,3-Dichlorobenzene	1.1 ug/L		Perylene	1.5 ug/L		Temp. Influent Minimum	°C
	1,4-Dichlorobenzene	1.7 ug/L		Phenanthrene	0.4 ug/L		Temp. Rise Maximum	°C
	Bromodichloromethane	0.8 ug/L		Pyrene	0.4 ug/L		Temp. Rise Mean	°C
	Bromoform	3.7 ug/L	20	2,3,4,5-Tetrachlorophenol	0.4 ug/L		Temp. Rise Minimum	°C
	Bromomethane	3.7 ug/L		2,3,4,6-Tetrachlorophenol	2.8 ug/L		Volume Discharged-Total	m^3
	Carbon tetrachloride	1.3 ug/L		2,3,4-Trichlorophenol	0.6 ug/L	E1	Iron, Unfiltered Total	20 ug/L
	Chlorobenzene	0.7 ug/L		2,3,5,6-Tetrachlorophenol	1.6 ug/L	E2	Average Residual Oxidants	0.1 mg/L
	Chloroform	0.7 ug/L		2,3,5-Trichlorophenol	1.3 ug/L		Maximum Residual Oxidants	0.1 mg/L
	Chloromethane	3.7 ug/L		2,4,5-Trichlorophenol	1.3 ug/L		Minimum Residual Oxidants	0.1 mg/L
	Cis-1,3-Dichloropropylene	1.4 ug/L		2,4,6-Trichlorophenol	1.3 ug/L		Total Residual Oxidants	0.1 mg/L
	Dibromochloromethane	1.1 ug/L		2,4-Dichlorophenol	1.7 ug/L	E3	Diethanolamine	100 ug/L
	Ethylene dibromide	1 ug/L		2,4-Dimethylphenol	7.3 ug/L	E4	Biochemical Oxygen Demand (5D)	0.5 mg/L
	Methylene chloride	1.3 ug/L		2,4-Dinitrophenol	42 ug/L			

Appendix C

Electric Power Generation Sector
MISA Toxicity Results

Table 1
MISA Toxicity Results - Fossil Stations

Effluent	Station	Control Point	Rainbow trout			Daphnia magna		
			Samples	Toxic	LC50 >100%	Samples	Toxic	LC50 >100%
Ash Transport Water Treatment System	Atikokan	0200	12	0	1	12	2	1
	Lakeview	0200	12	0	3	12	0	1
	Lambton	0800	12	0	0	12	0	0
	Nanticoke (Lagoon)	0100	12	10	2	12	10	1
	Nanticoke (Lines)	0300	7	0	3	7	0	0
	Thunder Bay	0200	12	0	2	12	0	1
Coal Pile Effluent	Lakeview	1800	14	1	0	14	0	1
	Lambton, Lake Lambton	1100	12	0	0	12	0	0
WTP - Neutralization Sump	Atikokan	0800	12	1	0	11	2	8
	Lennox (Settling Pond)	2300	11	0	1	12	0	2
	Thunder Bay	1500	12	8	0	12	8	1
Oily Water Separator	Atikokan	0600	12	0	0	12	0	2
	Lakeview	2300	12	1	0	12	4	2
	Lakeview	2400	11	0	1	11	1	4
	Lennox	0300	11	0	3	12	0	2
	Thunder Bay	1100	12	0	0	12	0	1

Table 1 (cont'd)
MISA Toxicity Results - Fossil Stations

Effluent	Staton	Control Point	Rainbow trout			Daphnia magna		
			Samples	Toxic	LC50 >100%	Samples	Toxic	LC50 >100%
Boiler Blowdown	Atikokan	0300	12	4	7	12	12	0
	Lakeview, Unit 1	0900	1	0	0	1	1	0
	Unit 2	1000	1	0	1	1	1	0
	Unit 3	1100	4	2	1	4	4	0
	Unit 4	1200	5	2	1	5	5	0
	Unit 7	1500	2	2	0	2	2	0
	Unit 8	1600	2	2	0	2	2	0
	Lambton, Unit 1	0400	3	1	1	3	3	0
	Unit 2	0500	3	1	2	3	3	0
	Unit 3	0600	2	1	1	2	2	0
	Unit 4	0700	4	2	1	4	4	0
	Lennox, Unit 1	1100	1	0	1	2	2	0
	Unit 2	1200	4	2	1	4	4	0
	Unit 3	1300	2	1	1	2	2	0
	Unit 4	1400	4	1	2	4	4	0

Table 1 (cont'd)
MISA Toxicity Results - Fossil Stations

Effluent	Staton	Control Point	Rainbow trout			Daphnia magna		
			Samples	Toxic	LC50 >100%	Samples	Toxic	LC50 >100%
Boiler Blowdown	Nanticoke, Unit 1	1200	2	2	0	2	2	0
	Unit 2	1300	2	2	0	2	2	0
	Unit 3	1400	2	1	1	2	2	0
	Unit 4	1500	2	2	0	2	2	0
	Unit 5	1600	1	1	0	1	1	0
	Unit 6	1700	2	1	0	2	2	0
	Unit 7	1800	2	0	0	2	2	0
	Unit 8	1900	2	2	0	2	2	0
	Thunder Bay, Unit 2	0500	7	4	2	7	7	0
	Unit 3	0600	5	2	2	5	5	0

Table 1 (cont'd)
MISA Toxicity Results - Fossil Stations

Effluent	Station	Control Point	Rainbow trout			Daphnia magna		
			Samples	Toxic	LC50 >100%	Samples	Toxic	LC50 >100%
Condenser Cooling Water	Atikokan TGS	0100	4	0	0	4	0	0
	Lakeview TGS	0100	4	0	0	4	0	0
	Lambton TGS	0200	4	0	0	4	0	0
	Lennox TGS	0200	3	0	1	4	0	0
	Nanticoke TGS	0200	3	0	0	4	0	0
	RL Hearn TGS	0300	4	0	0	4	0	0
	Thunder Bay TGS	0100	4	0	0	4	0	1
Service Cooling Water	Lambton, Unit 1 Transformer	1300	4	0	0	4	0	0
	Lambton, Unit 2 Transformer	1800	3	0	0	3	0	0
	Lennox, Unit 1,2 Transformer	1500	3	0	0	4	0	1
	Lennox, Unit 3,4 Transformer	1600	3	0	0	4	0	0
Intake Water	Atikokan	1000	12	0	0	9	0	0
	Lakeview	2900	12	0	1	12	0	0
	Lambton	0100	12	0	2	12	0	0
	Lennox	2000	11	0	0	12	0	0
	Nanticoke	3000	12	0	2	12	0	0
	RL Hearn	0600	4	0	0	4	0	0
	Thunder Bay	1700	12	0	0	12	0	1

Table 2
MISA Toxicity Results - Nuclear Stations

Effluent	Station	Control Point	Rainbow trout			Daphnia magna		
			Samples	Toxic	LC50 >100%	Samples	Toxic	LC50 >100%
Radioactive Liquid Waste Management System	Bruce-A	0100	11	3	0	11	4	2
	Bruce-B	0100	12	0	4	12	3	4
	Darlington	0100	12	2	1	12	2	3
	Pickering	0200	12	2	3	12	3	4
Neutralization Sump	Bruce-A	1400	12	12	0	12	12	0
	Bruce-B	2000	12	2	1	11	1	2
	Darlington	2200	11	9	0	10	6	2
	Pickering	3100	11	1	1	12	1	0
Oil/Water Separator	Darlington	1900	11	3	2	11	4	0
	Pickering NGS-B	2700	11	3	3	10	0	3
	Pickering NGS-B	3600	10	2	1	8	0	2
Equipment Cleaning (Boiler Layup)	Pickering	3800	1	1	0	1	1	0

Table 2 (cont'd)
MISA Toxicity Results - Nuclear Stations

Effluent	Station	Control Point	Rainbow trout			Daphnia magna		
			Samples	Toxic	LC50 >100%	Samples	Toxic	LC50 >100%
Boiler Blowdown	Bruce-A, Unit 3	0800	5	2	3	5	2	2
	Unit 4	0900	7	2	4	7	2	3
	Bruce-B, Unit 6	1100	4	0	1	4	0	0
	Unit 7	1200	4	1	2	4	0	0
	Unit 8	1300	4	0	2	4	0	0
	Darlington, Unit 2	1700	8	3	2	8	4	3
	Pickering, Unit 1	1100	2	2	0	3	3	0
	Unit 2	1200	5	5	0	5	5	0
	Unit 4	1400	4	4	0	4	4	0
	Unit 5	1500	3	2	1	3	3	0
	Unit 6	1600	3	2	1	3	2	0
	Unit 7	1700	3	1	2	2	2	0
	Unit 8	1800	3	3	0	3	3	0

Table 2 (cont'd)
MISA Toxicity Results - Nuclear Stations

Station	Effluent	Control Point	Rainbow trout			Daphnia magna		
			Samples	Toxic	LC50 >100%	Samples	Toxic	LC50 >100%
Condenser Cooling Water								
Bruce-A		1000	4	0	0	4	0	0
Bruce-B		1400	4	0	0	4	0	0
Darlington		1800	4	0	0	4	0	0
Pickering	Unit 3: NGS-A	1900	4	0	1	4	0	0
	Unit 4: NGS-A	2000	4	0	0	4	0	0
	Unit 1,2: NGS-A	2100	4	0	1	4	0	0
	NGS-B	3200	4	0	1	4	0	0
Service Cooling Water								
Pickering	Aux. Irradiated Fuel Bay	2200	4	0	1	4	0	0
	Reactor Bldg. Service Water: NGS-A	2300	4	0	1	4	0	0
	Reactor Bldg. Service Water: NGS-B	2400	4	2	1	4	2	1
	Heavy Water Upgrader (UPP)	2600	4	0	0	4	0	0
	Heavy Water Upgrader-A (Sulzer)	3300	4	0	0	4	0	0

Table 3
MISA Toxicity Results - Nuclear Support Facilities

Facility	Effluent	Control Point	Rainbow trout			Daphnia magna		
			Samples	Toxic	LC50 >100%	Samples	Toxic	LC50 >100%
Bruce Heavy Water Plant	Process Effluent	0500	12	0	1	12	0	0
	Cooling Water	0200	4	0	0	4	0	0
	Intake	0900	4	0	0	4	0	0
Bruce Nuclear Power Development	Sewage Treatment Plant	0100	12	0	0	12	0	0
	STP-A Lake	0200	12	0	1	12	2	0
	STP-A NGS-A	0300	12	0	1	12	0	2
	STP-O	0400	12	0	1	12	0	1
	Cooling Water	1500	4	0	1	4	0	0
Darlington Construction Site	TRF Boiler Blowdown	0100	9	4	1	9	4	1
	Const. Boiler Blowdown	0200	6	5	0	6	3	1
	Compressor Cooling Water	0300	4	0	0	4	0	0
	Sewage Treatment Plant	0800	12	1	3	12	3	0
	Neutralization Sump	1100	12	4	1	12	8	1
	Intake	1200	12	0	1	12	0	0

Appendix D

Flow/Loadings Versus Power Production

Appendix D
Flow/Loading Versus Power Production
List of Figures

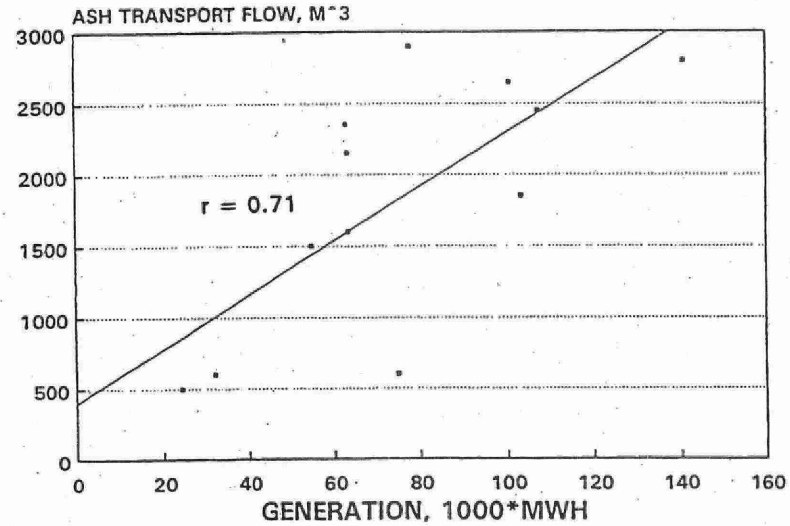
Figure	Page
Atikokan Ash Transport Water Treatment System TSS Loading Versus Generation	1
Atikokan Ash Transport Water Treatment System Flow Versus Generation	1
Lakeview Ash Transport Water Treatment System TSS Loading Versus Generation	2
Lakeview Ash Transport Water Treatment System Flow Versus Generation	2
Lambton Ash Transport Water Treatment System TSS Loading Versus Generation	3
Lambton Ash Transport Water Treatment System Flow Versus Generation	3
Nanticoke Ash Transport Water Treatment System TSS Loading Versus Generation	4
Nanticoke Ash Transport Water Treatment System Flow Versus Generation	4
Thunder Bay Ash Transport Water Treatment System TSS Loading Versus Generation	5
Thunder Bay Ash Transport Water Treatment System Flow Versus Generation	5
Atikokan Neutralization Sump TSS Loading Versus Generation	6
Atikokan Neutralization Sump Flow Versus Generation	6
Lakeview Neutralization Sump TSS Loading Versus Generation	7
Lakeview Neutralization Sump Flow Versus Generation	7
Lambton Neutralization Sump TSS Loading Versus Generation	8
Lambton Neutralization Sump Flow Versus Generation	8
Nanticoke Neutralization Sump TSS Loading Versus Generation	9
Nanticoke Neutralization Sump Flow Versus Generation	9
Thunder Bay Neutralization Sump TSS Loading Versus Generation	10
Thunder Bay Neutralization Sump Flow Versus Generation	10
Bruce-A Radioactive Liquid Waste Management System Flow Versus Generation	11
Bruce-A Radioactive Liquid Waste Management System TSS Loading Versus Generation	11
Bruce-B Radioactive Liquid Waste Management System Flow Versus Generation	12
Bruce-B Radioactive Liquid Waste Management System TSS Loading Versus Generation	12
Pickering Radioactive Liquid Waste Management System Flow Versus Generation	13
Pickering Radioactive Liquid Waste Management System TSS Loading Versus Generation	13
Bruce-A Neutralization Sump Flow Versus Generation	14
Bruce-A Neutralization Sump TSS Loading Versus Generation	14
Bruce-B Neutralization Sump Flow Versus Generation	15
Bruce-B Neutralization Sump TSS Loading Versus Generation	15
Pickering Neutralization Sump Flow Versus Generation	16
Pickering Neutralization Sump TSS Loading Versus Generation	16

Notes:

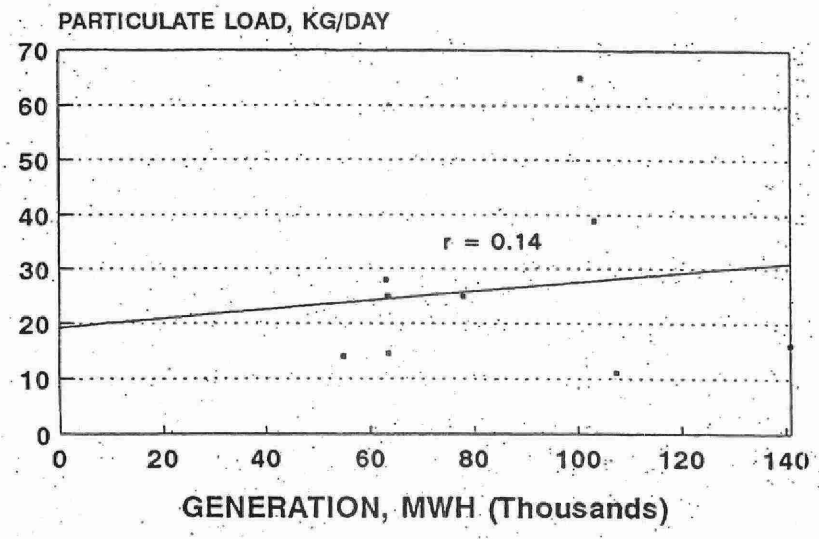
"r" value on figures is the correlation coefficient. Values of r can lie between the extremes of 0 (no demonstrated correlation) and ± 1 (perfect correlation)

Figures for fossil stations are taken from "Ontario Hydro, A Review of Production Based Loadings at Ontario Hydro's Thermal Generating Stations, October 15, 1992, TOB-07293."

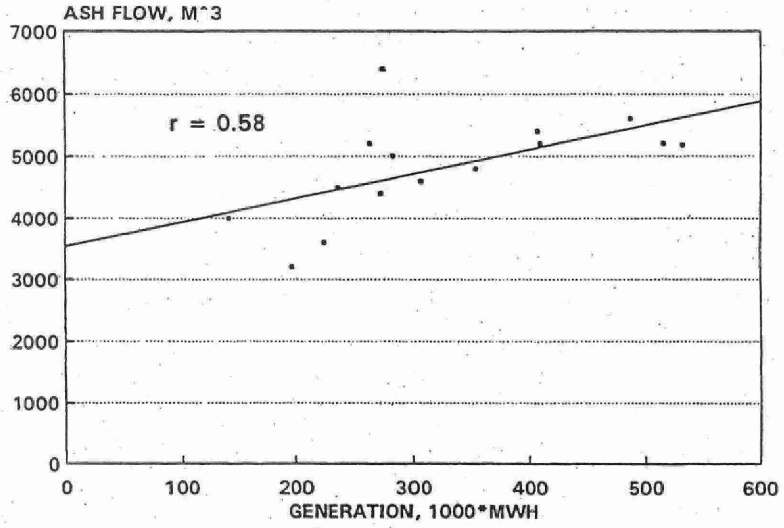
ATIKOKAN ASH FLOW VS GENERATION



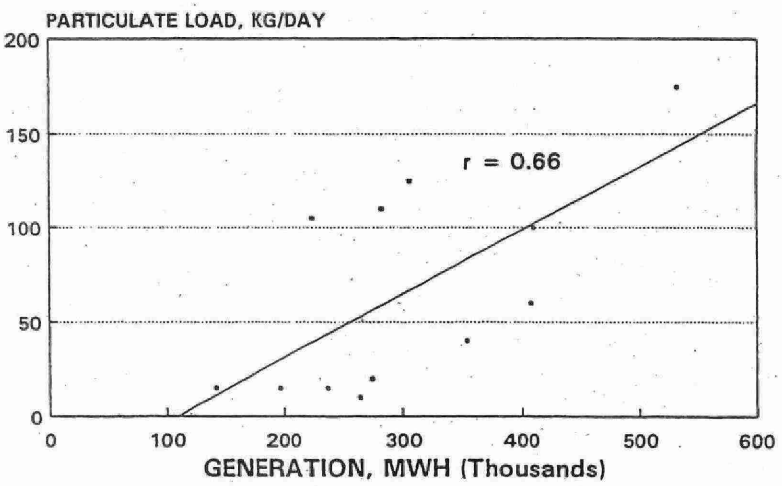
ATIKOKAN PARTICULATE LOAD VS GENERATION ASH TRANSPORT SYSTEM



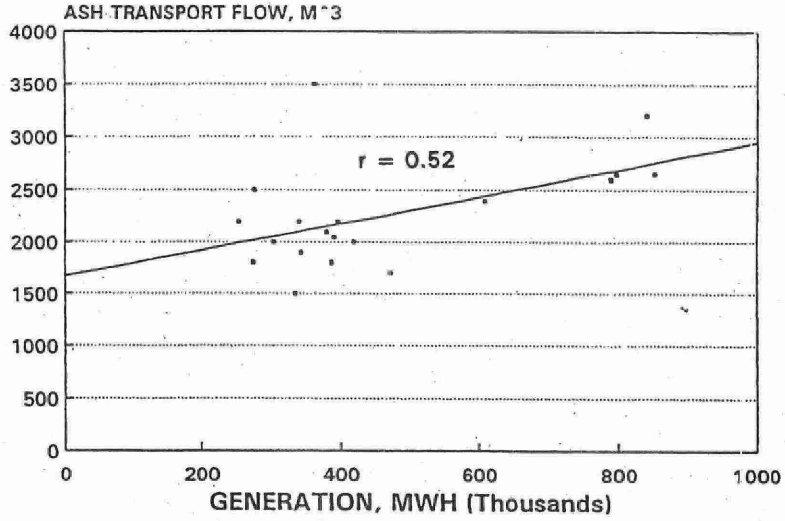
LAKEVIEW ASH FLOW VS GENERATION



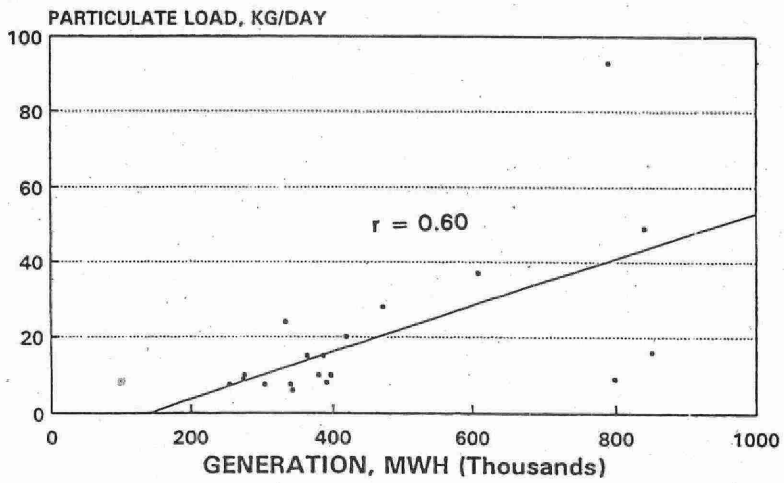
LAKEVIEW PARTICULATE LOAD VS GENERATION
ASH TRANSPORT SYSTEM



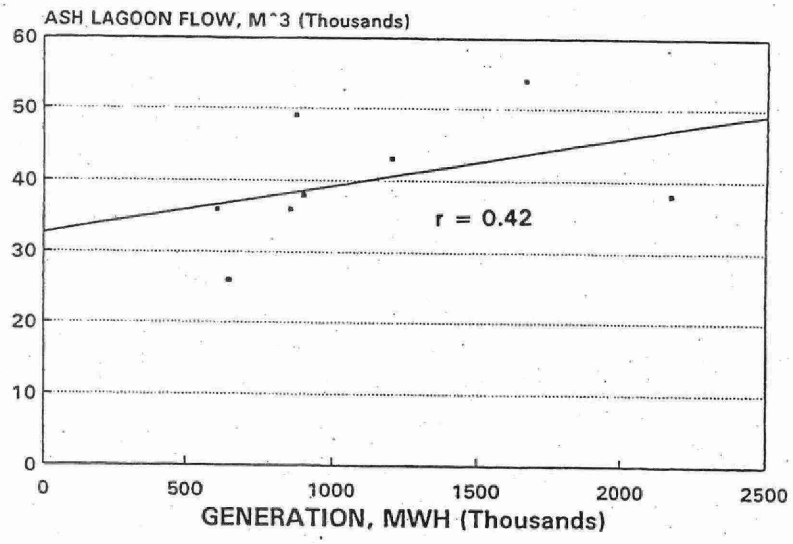
LAMBTON ASH FLOW VS. GENERATION



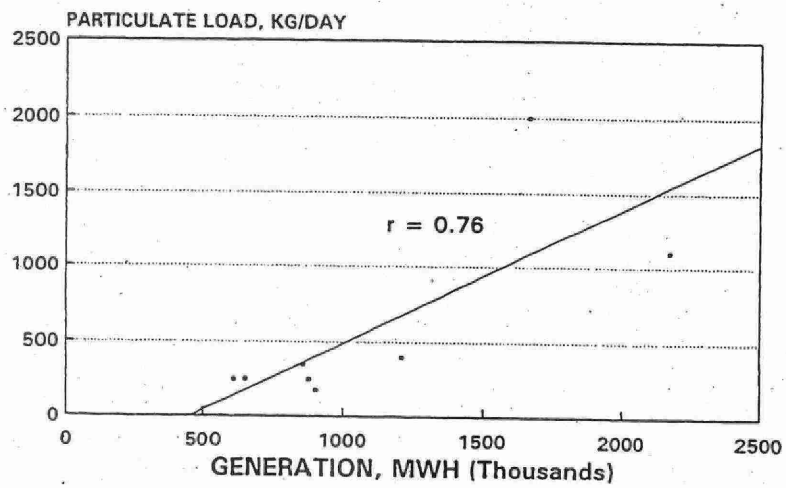
LAMBTON PARTICULATE LOAD VS GENERATION ASH TRANSPORT SYSTEM



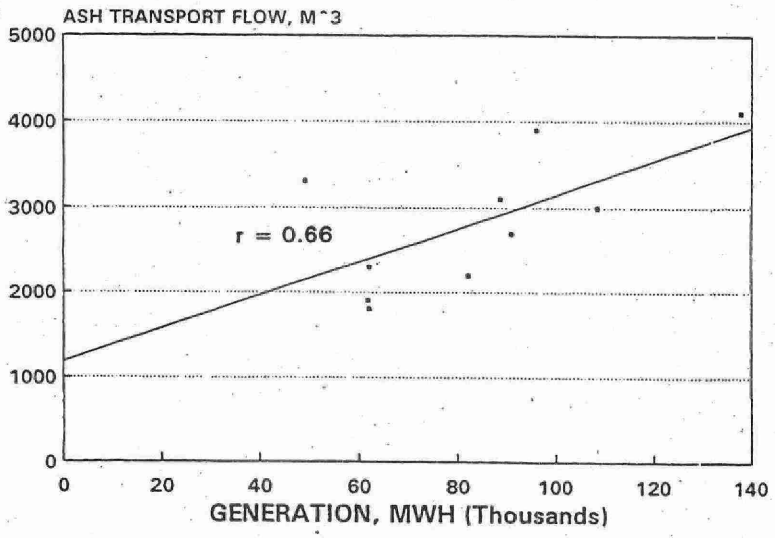
NANTICOKE ASH LAGOON FLOW VS. ENERGY



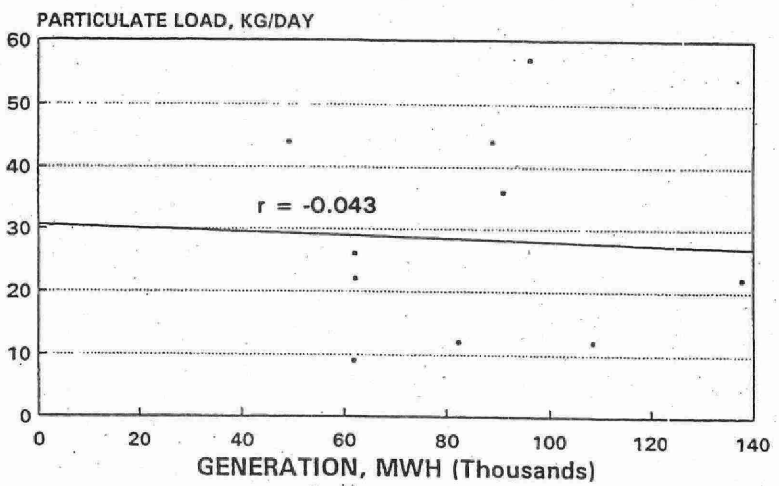
NANTICOKE PARTICULATE LOAD VS GENERATION
ASH TRANSPORT SYSTEM



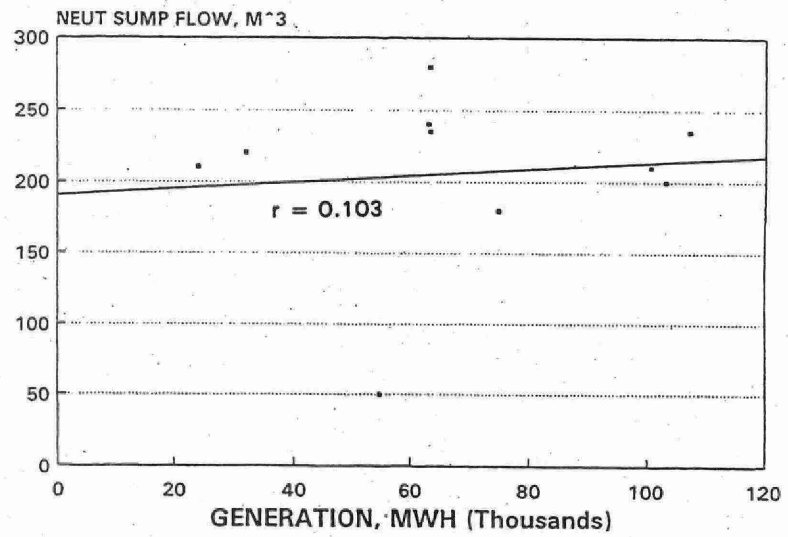
THUNDER BAY ASH FLOW VS. GENERATION



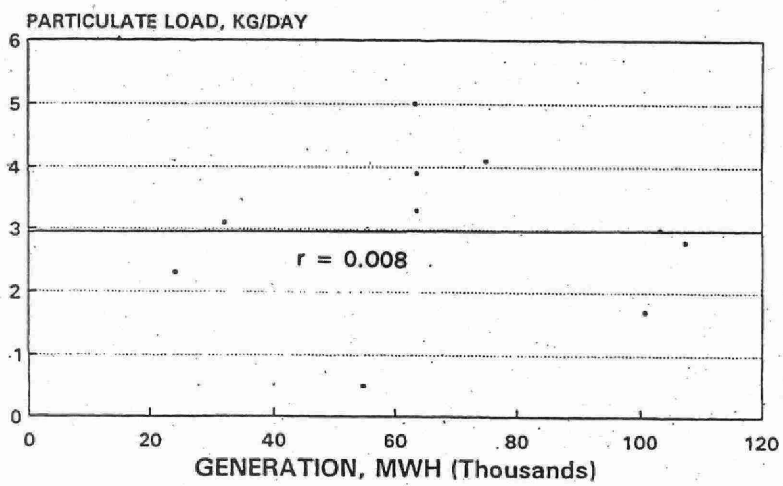
T'BAY PARTICULATE LOAD VS GENERATION
ASH TRANSPORT SYSTEM



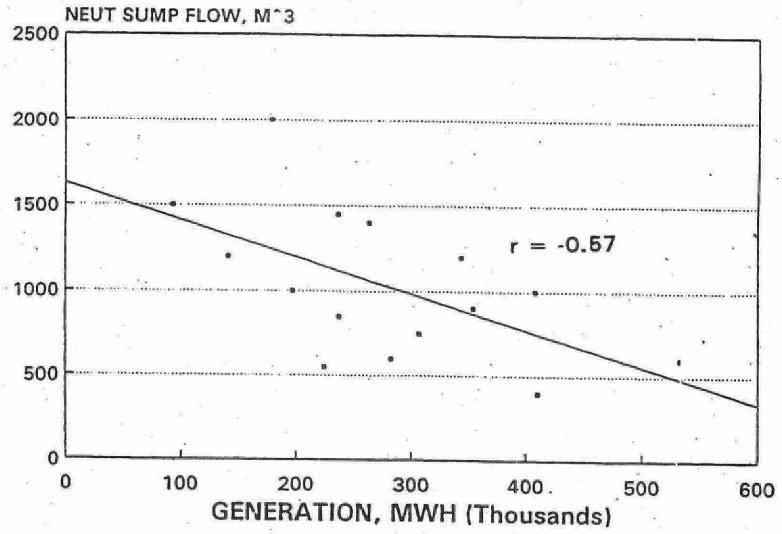
ATIKOKAN NEUT SUMP FLOW VS GENERATION



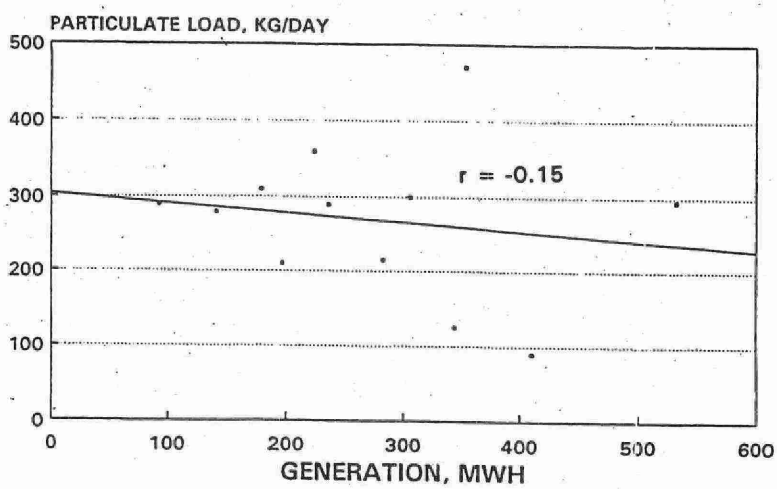
ATIKOKAN PARTICULATE LOAD VS GENERATION NEUTRALIZATION SUMP



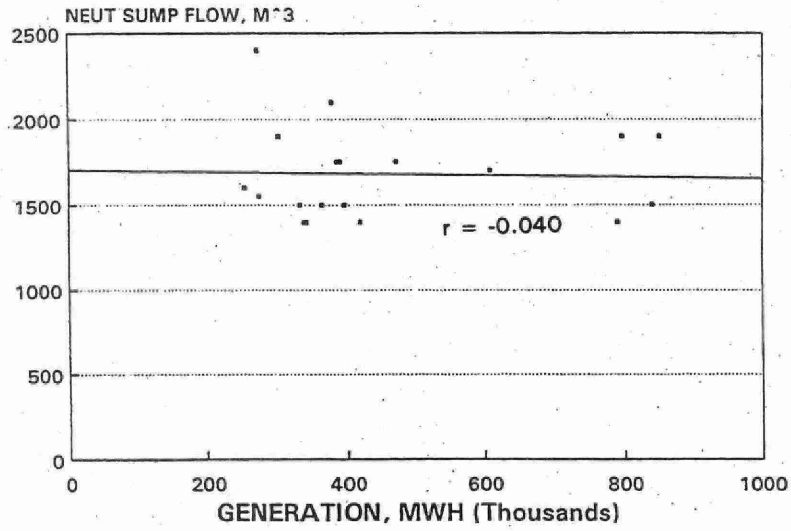
LAKEVIEW NEUT SUMP FLOW VS GENERATION



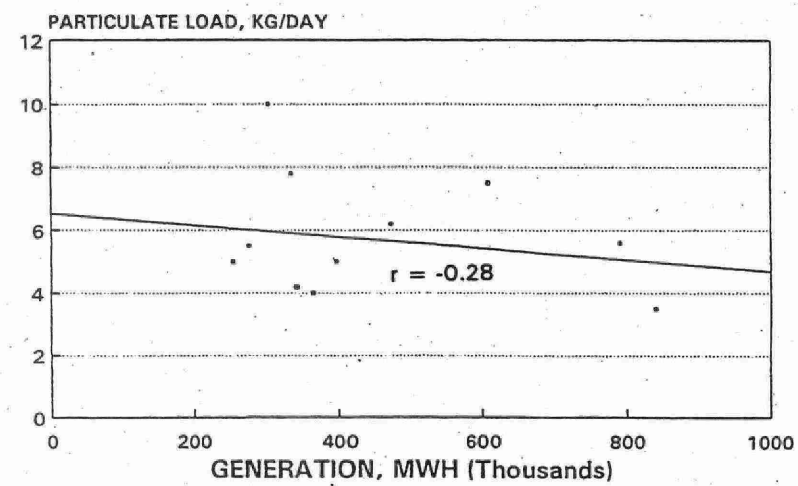
LAKEVIEW PARTICULATE LOAD VS GENERATION NEUTRALIZATION SUMP



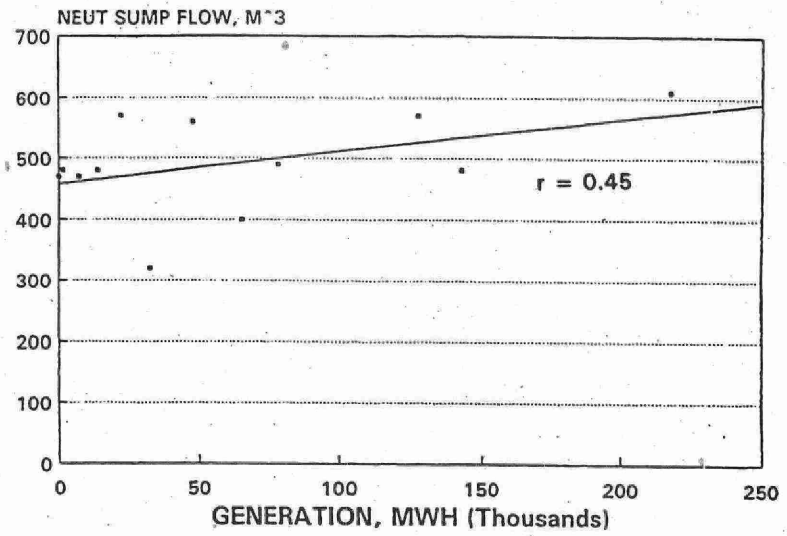
LAMBTON NEUT SUMP FLOW VS. GENERATION



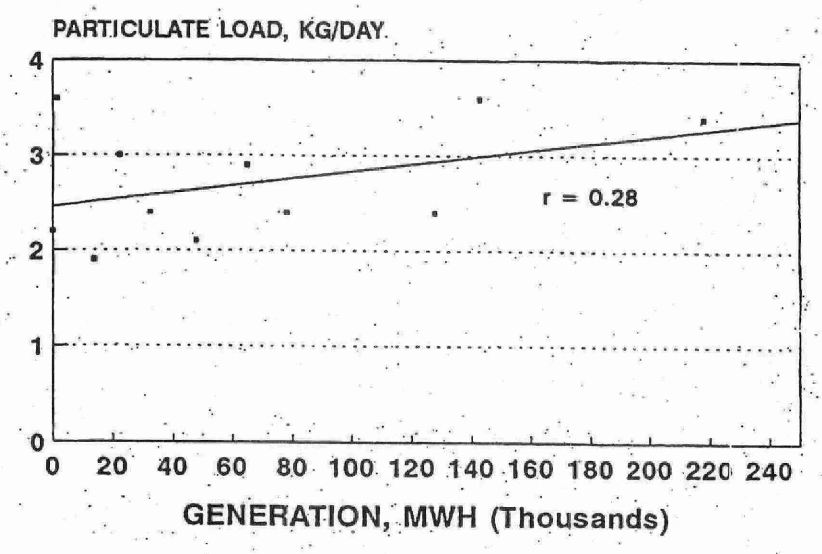
LAMBTON PARTICULATE LOAD VS GENERATION NEUTRALIZATION SUMP



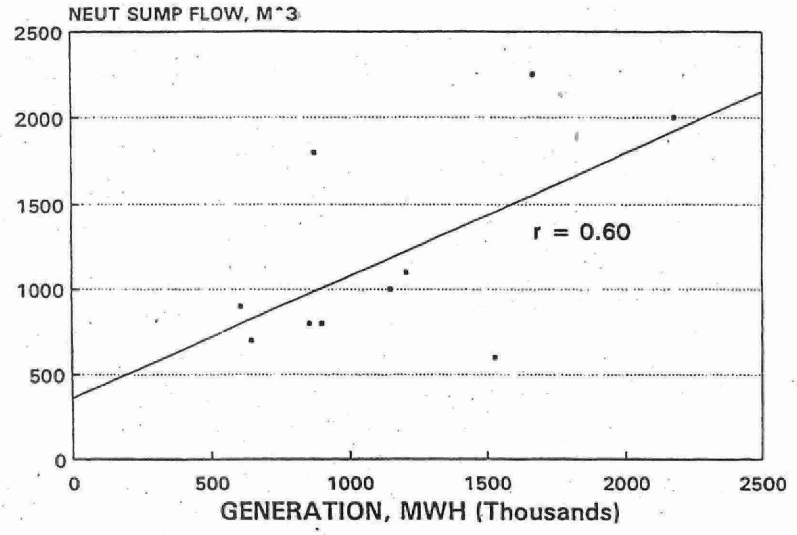
LENNOX NEUT SUMP FLOW VS GENERATION



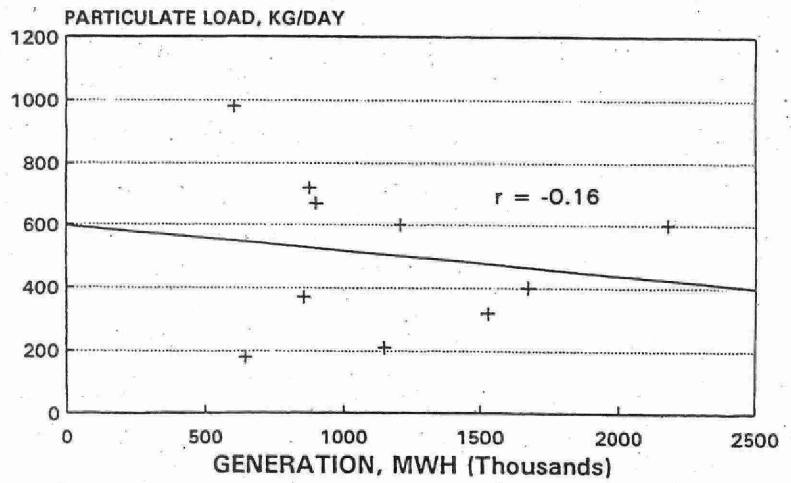
LENNOX PARTICULATE LOAD VS GENERATION NEUTRALIZATION SUMP



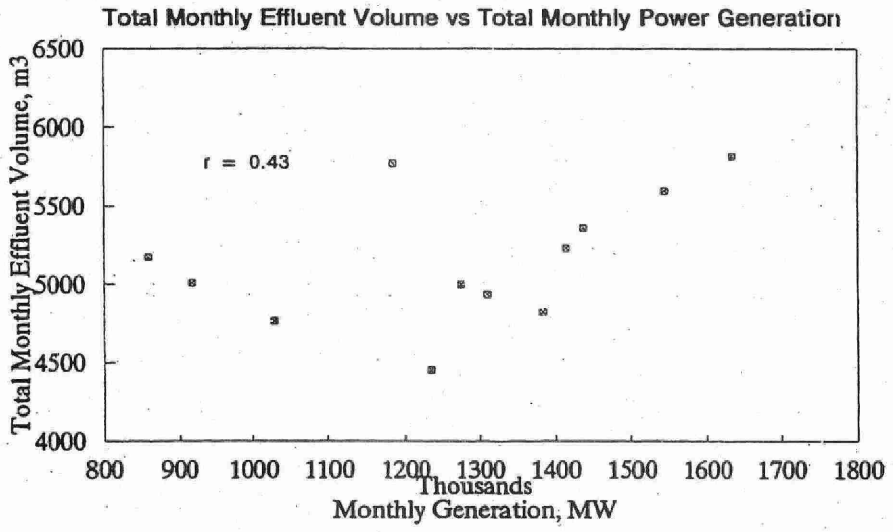
NANTICOKE NEUT SUMP FLOW VS GENERATION

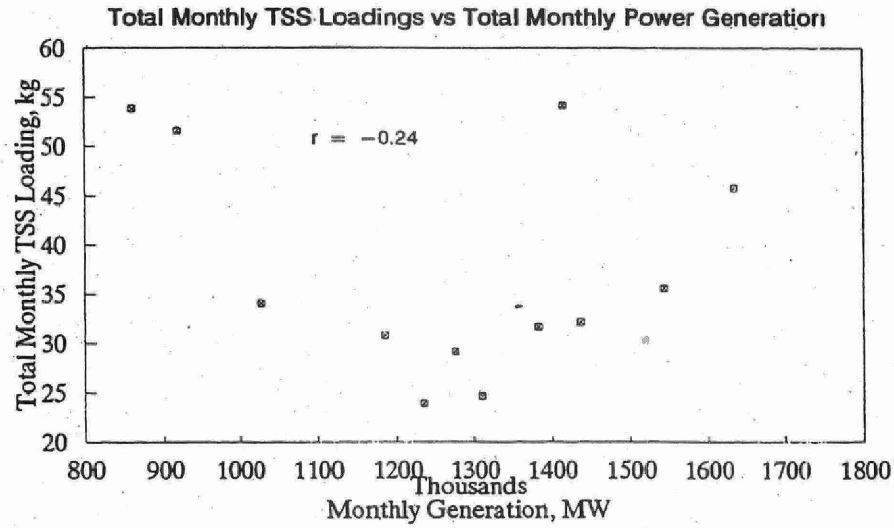


NANTICOKE PARTICULATE LOAD VS GENERATION NEUTRALIZATION SUMP

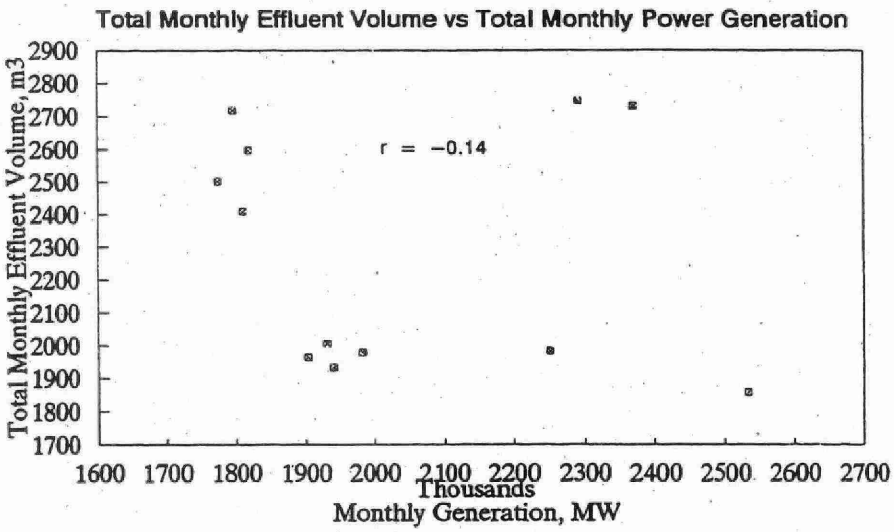


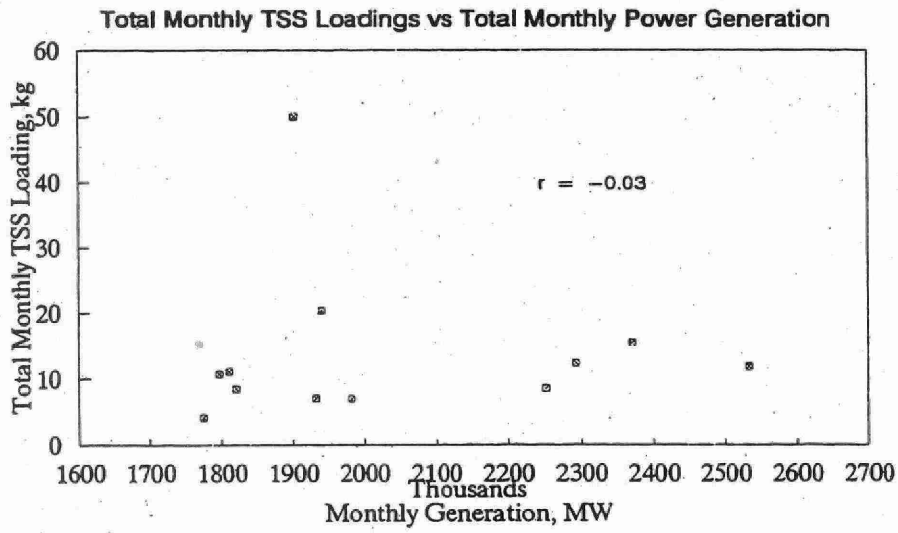
Bruce NGS – A
Radioactive Liquid Waste Management (RLWM) System



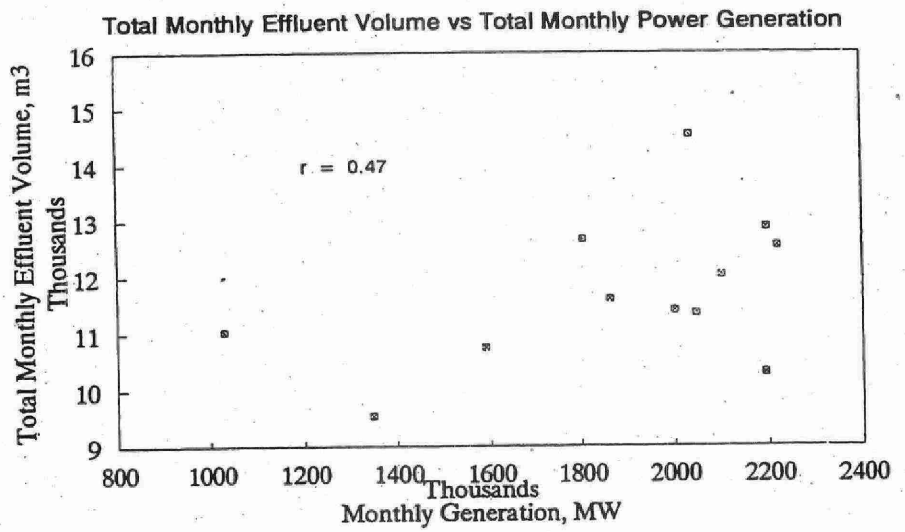


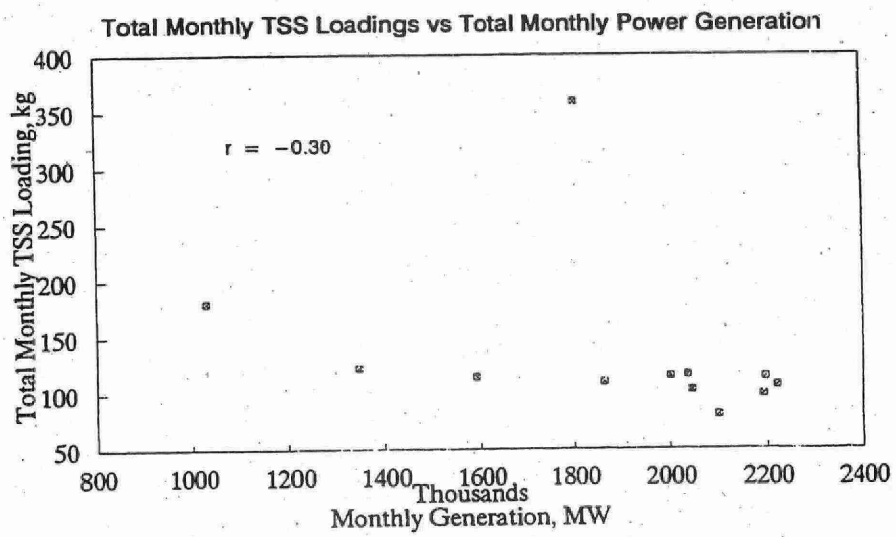
Bruce NGS – B
Radioactive Liquid Waste Management (RLWM) System



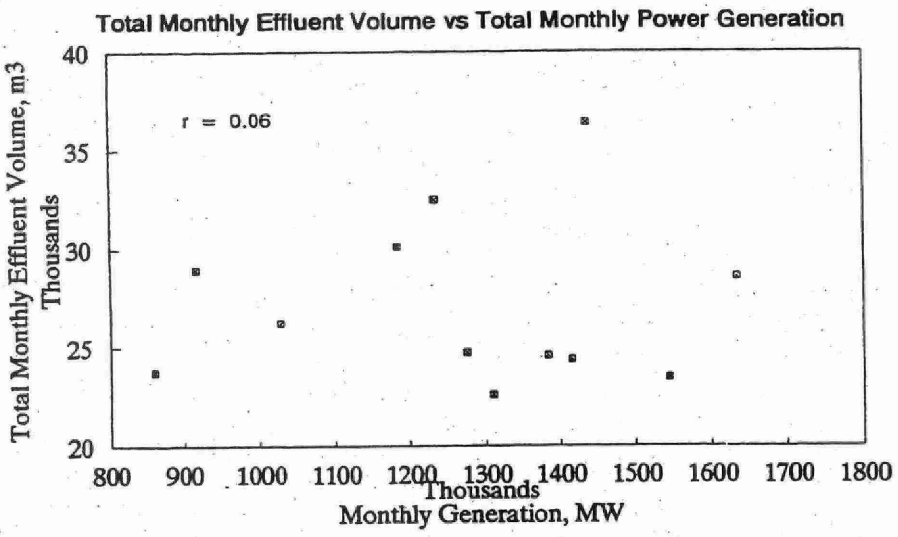


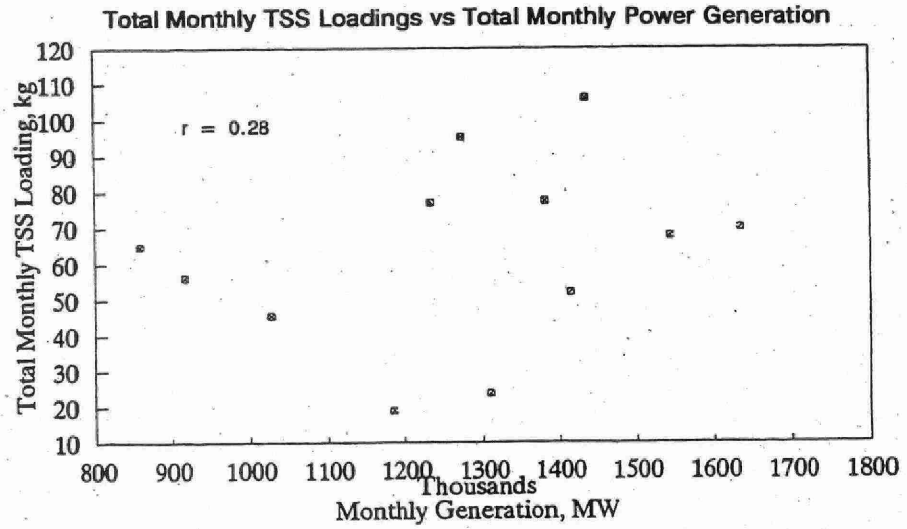
Pickering NGS – A&B
Radioactive Liquid Waste Management (RLWM) System



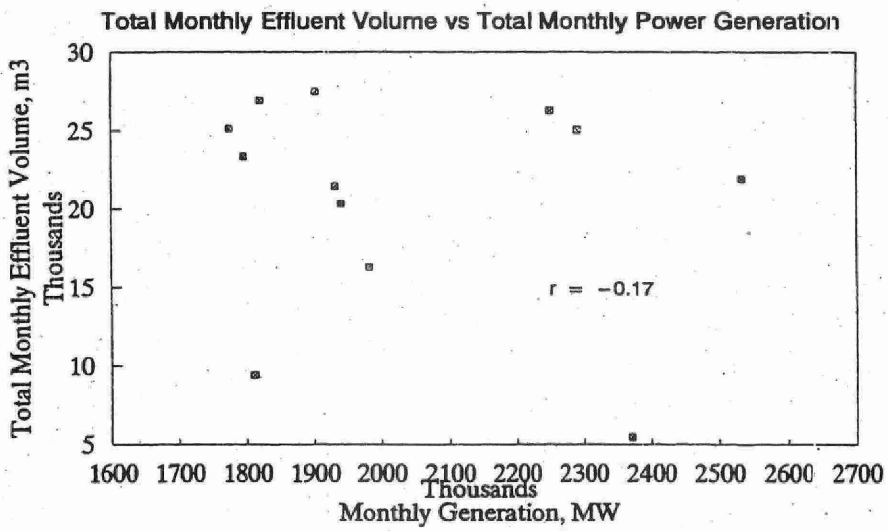


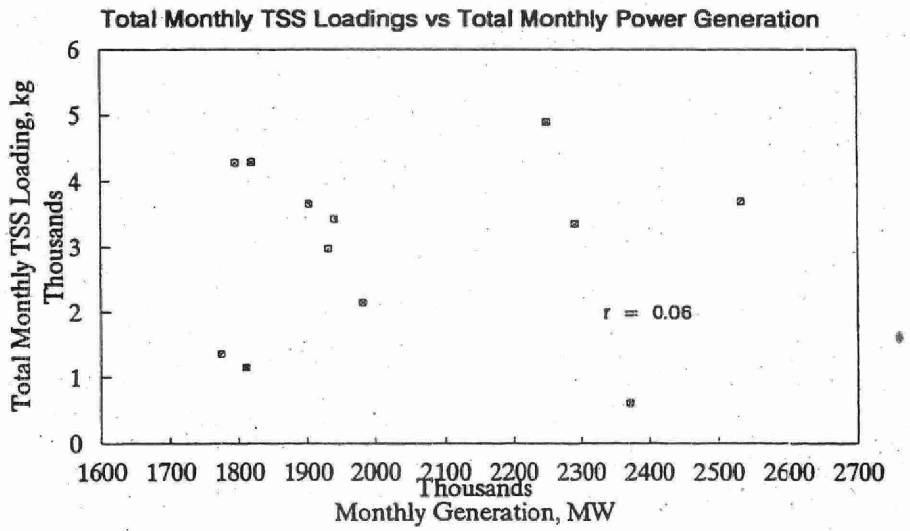
Bruce NGS – A
Neutralization Sump Effluent



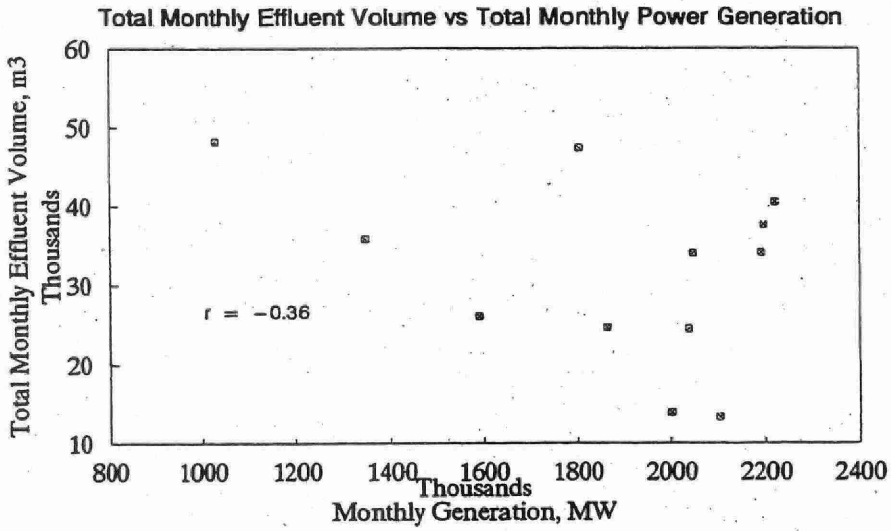


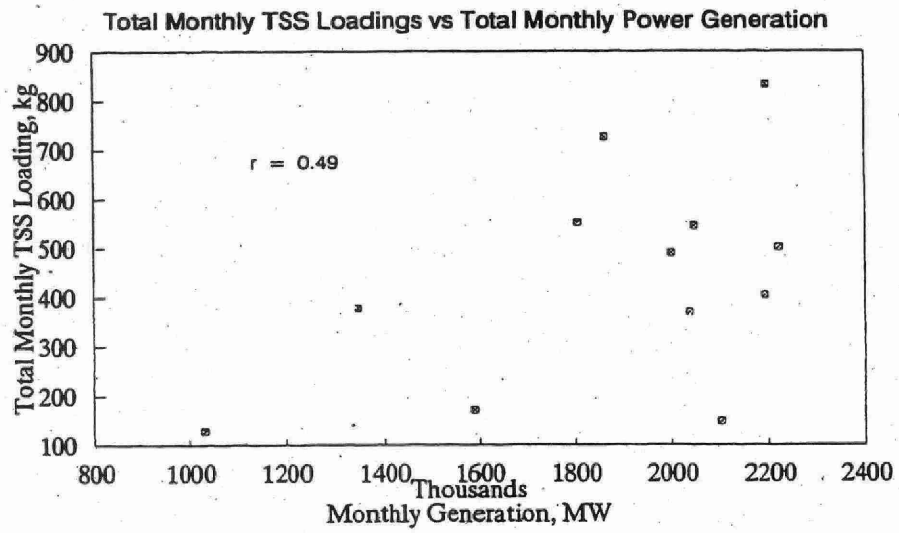
Bruce NGS – B
Neutralization Sump Effluent

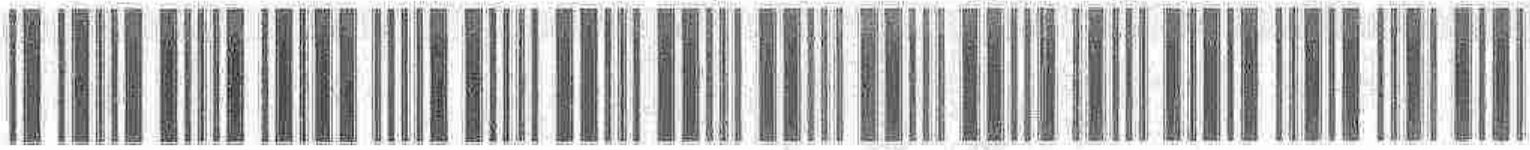




Pickering NGS – A&B
Neutralization Sump Effluent






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